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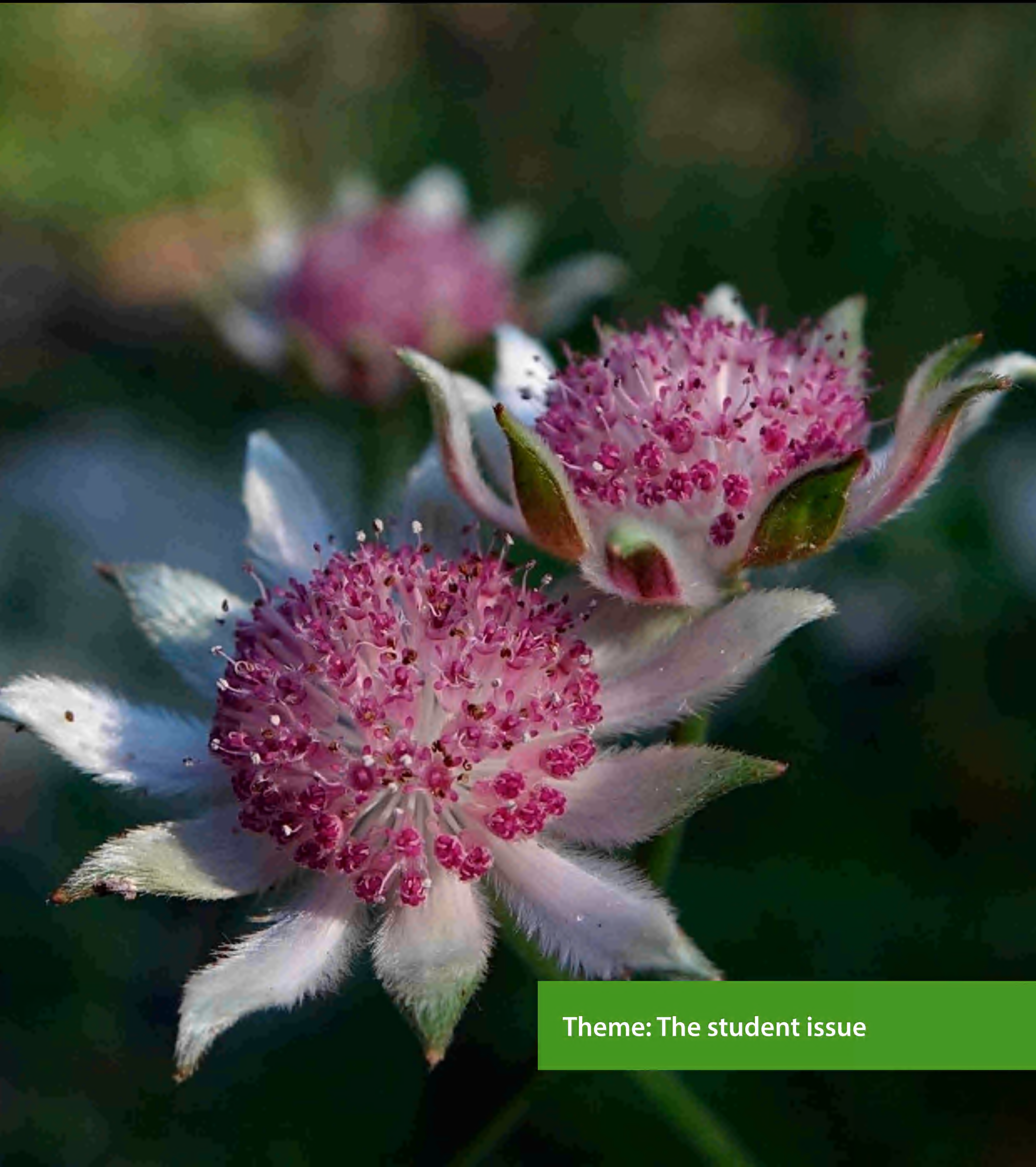

Theme: The student issue

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ANPC National Office

GPO Box 1777
Canberra, ACT 2601, Australia

T (02) 6250 9509 | **F** (02) 6250 9599
E anpc@anpc.asn.au
W www.anpc.asn.au

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Lucy Commander, Martin Driver, Jo Lynch, Amelia Martyn Yenson

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E info@nzpcn.org.nz
W www.nzpcn.org.nz

Front cover: Photo of *Actinotus forsythii* (Pink flannel flower) in bloom. Photo: Lloyd Hedges

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Editor
Heidi Zimmer

Associate Editors
Nathan Emery and Selga Harrington

Editorial Team
Lucy Commander, Andrew Crawford, Michelle Haby, Jo Lynch, Melissa Millar

Layout & Graphic Design
Siobhan Duffy

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research and diary dates are welcome. General articles on any plant conservation issue are most welcome.

The deadline for the **Winter 2020** issue is 1 May. If you are intending to submit an article or wish to discuss possibilities, please email the editor, Heidi Zimmer: **editor@anpc.asn.au**.

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From the editor

NATHAN EMERY

A warm welcome to the summer issue of *Australasian Plant Conservation*. This issue represents an exciting new theme where we shine a spotlight on the important research that students have been, or are currently, conducting in plant science. Dubbed the 'Student's issue', we have five articles that cover a vast array of topics, including germination, future habitat assessment, *ex situ* cryostorage and translocation. I would encourage any student working in plant science to consider submitting an article for future issues of *APC* (not just the Student issue)!

We begin our series of student articles with an investigation into the germination of the fire ephemeral, *Actinotus forsythii*. Using a series of experiments investigating the role of temperature and fire-related cues on germination, Ruby Paroissien identifies warmer temperatures and smoke are key to promoting germination of this stunning native species. Next, Casey Kirchhoff illustrates that rapid assessments of species' suitability of habitat can be achieved by combining open-access species data with the Biodiversity and Climate Change Virtual Library online toolkit. In her article, Casey modelled future habitat suitability under predicted climate scenarios for 19 endemic alpine plant species and demonstrated that over half of these species could experience a complete range retraction. Our next article is all about cryostorage (the *ex situ* storage of plant tissue in liquid Nitrogen) and its importance for storing plant species that cannot be stored under more common methods such as seedbanking. Lyndle Hardstaff outlines the methodology of cryo-preservation and follows this up with an overview of her initial experiments. With promising early results, we look forward to finding out how Lyndle's research progresses! Our final two student articles focus on translocation. Chantelle Doyle poses the tough question of whether plant translocations are a viable conservation option. Considering this, her research aims to critique the practical requirements of best practice translocations. Not only this but Chantelle also wants to hear from those of you who have been involved in translocations! Our final student article is a translocation case study of the Endangered *Persoonia hirsuta* by Samantha Andres. For this experimental planting, Samantha highlights the importance of a robust experimental design and post-planting monitoring program, which includes assessing the possible role of the soil biota of the recipient site in influencing plant survival.

We then have a series of three articles that begin with a timely reminder from Stephen Bell to double-check, or even triple-check, your threatened plant identifications to avoid incorrect allocation of conservation funds. Michael Mulvaney and co-authors report on a fantastic citizen science study in Canberra Nature Park. In this article, the authors describe how citizen scientists captured photos of orchids within the park that were analysed with environmental and fire data, leading to improved fire management practises for the park. Our final article is by Brett Summerell who introduces us to 2020 as the International Year of Plant Health, and an opportunity to promote the importance of plant health on humanity and the environment.

In keeping with the student theme, the ASBP news centres around bringing seed science to primary and secondary school students, and it is wonderful to see such positive feedback from the students involved. We then have three ANPC workshop reports on the new 'Healthy Seeds Project', an overview of the results from the Australian native seed industry survey, Martin Driver's report on the Current Barriers – Future opportunities, and a short communication from the 'Seeds for the Future' forum held last year. We then finish up the issue with a member profile, two book reviews, ANPC news and a research round up.

Phew, what a bumper issue! Thank you to all our contributors, and a special thanks to our student contributors!

Germination of the rarely seen Pink Flannel Flower (*Actinotus forsythii*; Apiaceae)

RUBY PAROISSIEN[1*], LLOYD HEDGES[2], JOHN PORTER[1] AND MARK OOI[1]
[1] School of Biological Earth & Environmental Sciences, UNSW Sydney, NSW 2052.
[2] Menai Wildflower Group, Australian Plants Society, NSW.
*Corresponding author: ruby.paroissien@gmail.com

Background

Fire is an important driver shaping the composition of plant communities in Australia. Fire ephemerals are a unique element of the fire-vegetation relationship, emerging in the first few months after fire and persisting only for one to several years. These species have a strong dependence on fire to germinate and, as ephemerals only live a short time in their plant phase, spend the majority of their life cycle as seeds in the soil. Consequently, it is likely that they have developed relatively complex and specific requirements to overcome dormancy and promote germination.

Fire ephemerals make up a significant component of the floras in Mediterranean-type rainfall climates, including Western Australia, California and South Africa, however, they are much less common in aseasonal rainfall climates like in south-eastern NSW. With support from the Menai Wildflower Group, we have been studying *Actinotus forsythii* (Pink Flannel Flower; Figures 1 and 2), one of the few fire ephemerals from the greater Sydney region in NSW, at the Centre for Ecosystem Science at the University of New South Wales.

Studying seeds and their germination cues may provide insight into how a species persists (Baskin and Baskin, 2014). Because of the dependence of fire ephemerals on very long-lived soil seed banks, it is highly likely that seeds of the Pink Flannel Flower would have deep dormancy. The type of dormancy species within the family Apiaceae have, either physiological or morphophysiological (Baskin and Baskin 2014), also indicates that seeds are likely to have specific germination requirements. This is similar to other physiologically dormant species from the region, including many Rutaceae, where dormancy is overcome with combinations of seasonal temperatures and germination responding to fire (Mackenzie *et al.* 2016; Collette and Ooi 2017).

Studies of fire ephemerals carried out in Western Australia have highlighted a significant increase in germination in response to smoke and heat (Baker *et al.* 2005). A seed burial experiment also suggested a strong dependence on seasonality as germination increased to 95% after a summer compared to a winter burial (Baker *et al.* 2005). Studies have also been carried out in the Sydney region, focusing on the more common Flannel Flower *Actinotus helianthi*, a closely related fire ephemeral, and have also demonstrated a complex dynamic of germination cues (Emery *et al.* 2011). We aimed to understand the dormancy and germination cues of the Pink Flannel Flower to give insights both for improving its use in cultivation and its ecology in the wild.

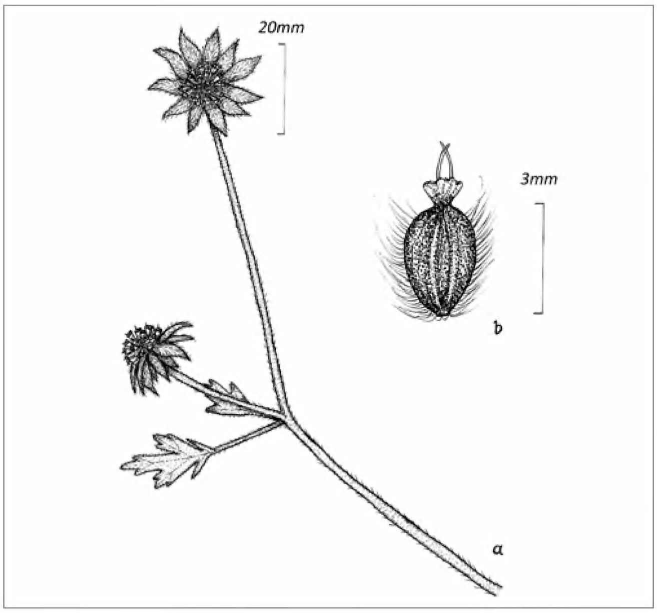

Figure 1. ***Actinotus forsythii*** **a - flower stem and b – seed. Illustration: Ruby Paroissien**

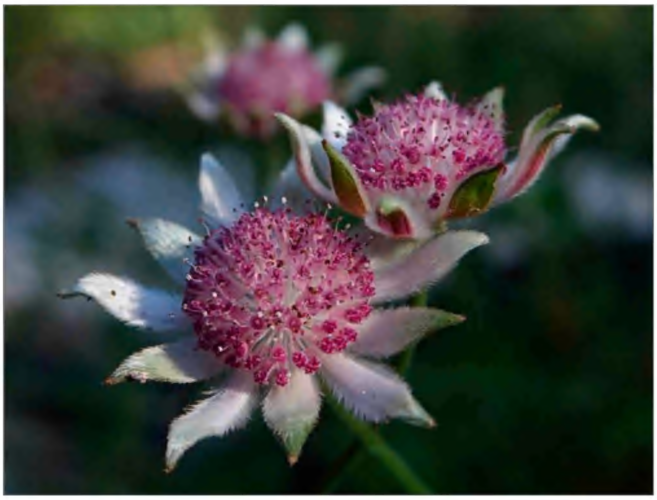

Figure 2. ***Actinotus forsythii*** **in flower. Photo: Lloyd Hedges**

Methods

We established an experiment to assess the germination requirements of *Actinotus forsythii*. Our main aims were to understand:

- Whether this species had specific seasonal temperature requirements for germination.
- The relative importance of the different fire cues, smoke and heat, for germination.
- If seeds could germinate in both light and dark conditions.

To do this, seeds were collected in March 2017 from plants cultivated by Lloyd Hedges at Menai Wildflower Group nursery. Parent seeds for cultivated plants were collected from near Lithgow, NSW. We first assessed viability of the seed lot by cutting three replicates of 20 seeds in half and observing if the endosperm was healthy (Ooi *et al.* 2004). An experiment was then implemented to test:

1. Seasonal temperatures: incubators were used to mimic seasonal day/night temperatures of 11/3°C, 18/6°C, or 25/11°C approximating winter, spring or autumn, and summer conditions respectively, for the study region.
2. Fire cues: smoke water was generated through burning leaf litter from the local area and pumping the resulting smoke through distilled water for 3 hours.
3. Light and dark: incubators had light/dark conditions on a 12/12 hour cycle. Constant dark was implemented by covering trays in two layers of aluminium foil.

Four replicates of 25 seeds were sown on water agar (7 g/L) in 9cm petri dishes for each treatment. Treatments included the control, smoke, dark and smoke plus dark. A heat and smoke plus heat treatment were also carried out at the 25/11°C incubation temperature only. The smoke treatment was applied using smoke water at a concentration of 2%, with 1ml spread onto the top of the agar before seeds were sown. Heat was applied to heat treatment seeds for 10 minutes at 80°C in an oven. Dishes were incubated at the three different seasonal temperatures on 12 h/12 h light/dark and maximum/minimum temperature cycles. Petri dishes were checked once a week for 7 weeks except for the dark and dark plus smoke treatments, which were checked just once after 50 days. Final germination was calculated based on number of seeds germinated divided by the number of viable seeds in each dish. Time to reach 50% of total seeds germinated (t_{50}) was calculated to assess the rate of germination by fitting a linear model for the percentage of seeds germinated in each replicate against time and solving for $y = 50$. Germination data were analysed using two-factor Generalised Linear Models and T_{50} with ANOVA. Comparisons between treatment levels were made using Tukey's tests.

Results

After 50 days, seeds in the 11/3°C temperature had not germinated. However, at 18/6°C, germination of untreated seeds reached approximately 20% and smoke significantly increased this ($P = 0.006$). At 25/11°C, untreated seeds germinated to even greater levels (ca. 35%) and the slight increase with smoke was not significant. The dark treatments significantly reduced germination at both temperatures to negligible levels (Figure 3). The heat shock experiment indicated that fire-related temperatures did not increase germination (Figure 4). The rate of germination differed between seasonal temperatures. On average, T_{50} was 1.89 weeks (untreated seeds) and 1.84 weeks (smoke) at 25/11°C, and 3.45 weeks (untreated) and 3.02 weeks (smoke) at 18/6°C. Germination was significantly faster at 25/11°C ($F = 82.7$, df = 1, $P < 0.001$).

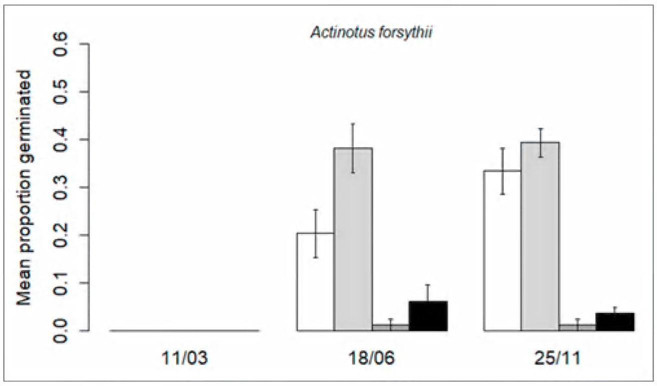

Figure 3. Final *Actinotus forsythii* seed germination after 50 days at the three different seasonal temperatures. Treatments: Control (☐), Smoke (░), Dark (▒), Dark and Smoke (■). Error bars are standard errors.

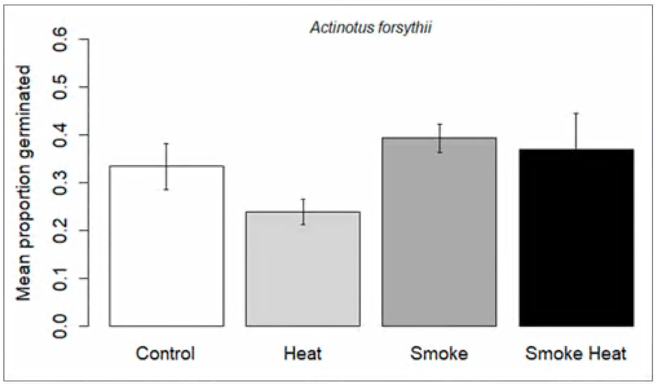

Figure 4. Final *Actinotus forsythii* seed germination after 50 days at temperature 25/11°C with factorial applications of heat (80°C) and smoke.

Conclusion

Specific seasonal temperatures are required for the Pink Flannel Flower, with germination strongly correlated with warmer seasons. Similar germination in spring/autumn and summer temperature regimes indicated that the species may have adapted to avoid emergence during very cold winter temperatures typical of higher elevations. *Actinotus forsythii* had a strong germination requirement for smoke, indicating that it would emerge after fire in the field, but no response to heat shock. Dark treatments also had a very strong inhibiting effect on germination, suggesting that seeds need to be near the surface where light can reach to ensure germination. This also has implications for cultivation of the species, in which germination in light conditions is recommended before sowing seeds. An unexpected result was that a relatively high overall proportion of seeds germinated, which may reflect that seeds were sourced from regularly watered cultivated plants, as seeds produced in harsher conditions in the wild tend to have deeper dormancy (Paroissien, Porter & Ooi, unpublished data).

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Rapid assessment of future habitat suitability: a case-study of the Snowy Mountains endemic alpine flora using the Biodiversity and Climate Change Virtual Library (BCCVL)

CASEY M. KIRCHHOFF

Centre for Ecosystem Science & The Evolution & Ecology Research Centre, School of Biological, Earth & Environmental Science, University of New South Wales.
Corresponding author: c.gibson@unsw.edu.au

Big ecological data and climate change

Recent years have seen an exponential increase in the amount and quality of ecological and climatic data freely available online. Ongoing digitisation of herbarium specimens provides a rich source of vouchered and verified botanical information spanning hundreds of years. Similarly, citizen science platforms such as iNaturalist and the Atlas of Living Australia (ALA) allow users to upload species occurrences in real-time via a smartphone app. This source of information is more prone to error but orders of magnitude greater in volume, with tens of millions of occurrence records generated in the past few years alone. Big data from these complementary sources can be used to understand complex ecological processes, including species range shifts, biotic interactions and responses to the changing abiotic environment. In response to the availability of ecological data, the tools to understand these processes are becoming increasingly sophisticated and user-friendly.

The cloud-based Biodiversity and Climate Change Virtual Library (BCCVL) is part of the ALA network that allows users of all skill levels to conduct sophisticated species distribution modelling and secondary experiments such as climate change projections within short timeframes (Hallgren *et al.* 2015). Species occurrences can be imported directly from the ALA data repository or cleaned within the ALA spatial portal and exported into the BCCVL. Educational tools are provided such that users can make informed decisions about algorithm selection and model outputs, to ensure that secondary experiments are projected from accurate species distribution models. Rapidly and easily assessing climate change impacts on future habitat suitability for a large number of species will benefit a wide range of users; for example, those looking to make informed decisions about threatened species management, restoration, and reintroductions.

As the climate warms, species' climatic envelopes are predicted to shift higher in both elevation and latitude (Hughes 2003). However, depending on the magnitude and pace of shift, tracking the climatic envelope may not be a viable option for species that occupy mountaintop habitat islands. The alpine zone of the New South Wales Snowy Mountains represents the highest (ca. 1850 m to 2228 m) and largest (ca. 100 m^2) contiguous alpine environment on the Australian mainland (Venn *et al.* 2017). Climate change is shifting the abiotic characteristics of the Snowy Mountains alpine region, particularly decreasing seasonal snow depth and duration (Sánchez-Bayo & Green 2013), and the longevity of semi-permanent snow patches (Green & Pickering 2008). As their climatic envelope shifts, the endemic alpine flora of the Snowy Mountains are effectively stranded on the 'roof of Australia'. Feldmark specialists such as *Colobanthus nivicola*, *Euphrasia alsa*, *Euphraisa collina* subsp. *lapidosa*, and *Ranunculus acrophilus*, are already restricted to the uppermost elevational niche that the Australian continent has to offer.

I conducted a case study of nineteen endemic alpine plants of the Snowy Mountain (Figure 1, per Costin *et al.* 2000) using the BCCVL to model suitable habitat under current climatic conditions, and whether the probability of suitable habitat will change in the future under different climate change scenarios. I expected that in the next 35 years under the business as usual climate change scenario (Representative Concentration Pathway 8.5), the probability of suitable habitat remaining on the Kosciuszko alpine plateau would severely contract for these alpine endemics.

Rapid species distribution modelling and climate change projections

I searched ALA and iNaturalist for occurrence records for each of the subject species. Data were cleaned to remove duplicates, spatial outliers, and records with spatial uncertainty > 1000 m. The multi-species distribution model was built using the following Australian Current Climate variables at 1km resolution: B03 Isothermality; B04 Temperature Seasonality; B07 Temperature Annual

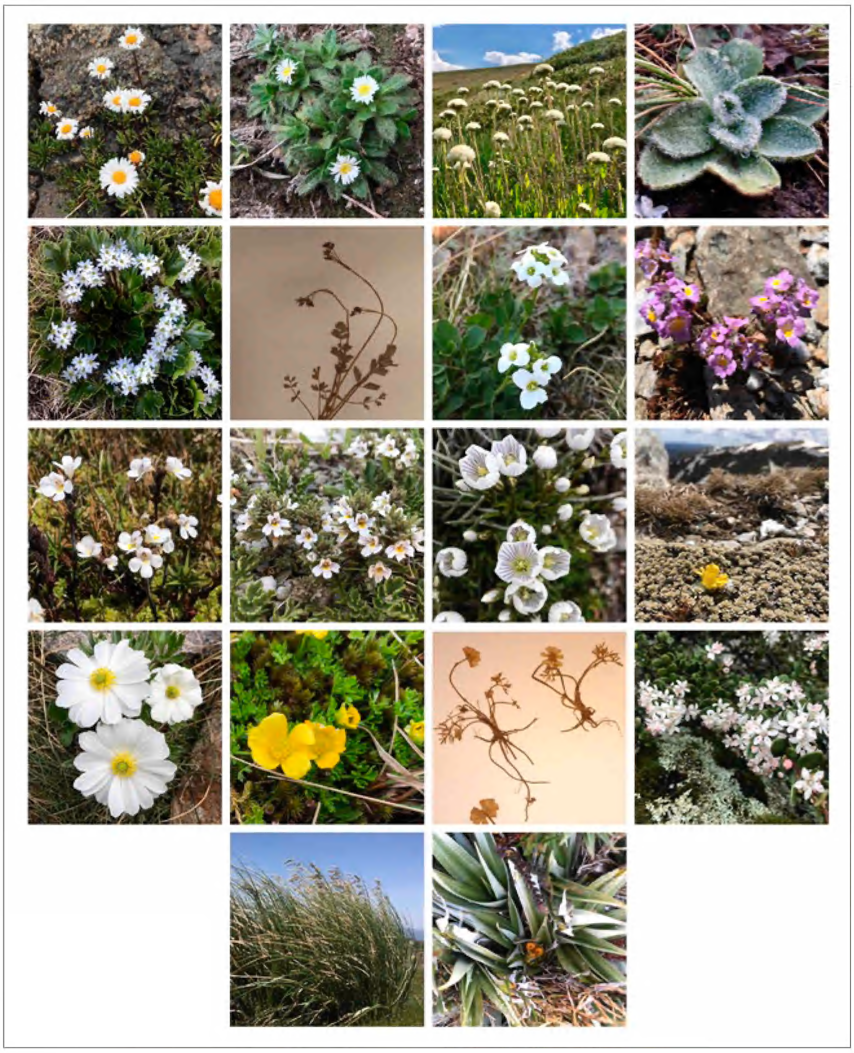

Figure 1. Eighteen of the Kosciuszko endemic alpine species (*Colobanthus nivicola* not shown). Top row left to right: *Brachyscome stolonifera*; *Pappochroma setosum*; *Craspedia leucantha*; *C. costiniana,* ASTERACEAE; *Dichosciadium ranunculaceum* var. *ranunculaceum*; *Gingidia algens*, APIACEAE; *Cardamine robusta*, BRASSICACEAE; *Euphrasia collina* subsp. *lapidosa*; *E. collina* subsp. *glacialis*; *E. alsa*, OROBANCHACEAE; *Gentianella muelleriana* subsp. *alpestris*, GENTIANACEAE; *Ranunculus acrophilus*; *R. anemoneus*; *R. niphophilus*; *R. dissectifolius*, RANUNCULACEAE; *Nematolepis ovatifolia*, RUTACEAE; *Chionochloa frigida*, POACEAE; *Astelia psychrocharis*, ASTELIACEAE. All photographs: Casey Kirchhoff.

Range; B10 Mean Temperature of the Warmest Quarter; B12 Annual Precipitation; and B15 Precipitation Seasonality. To assess whether any target species were predicted to have any suitable habitat outside of the Snowy Mountains region, the range was expanded to the entire IBRA 7 Australian Alps Bioregion. The Random Forest algorithm was chosen as it is robust to uneven and complex datasets, while being one of the most accurate machine learning algorithms available (BCCVL 2015). Climate change projections were based on the business as usual or 'worst case scenario' RCP 8.5, reflecting atmospheric carbon of 1370 ppm, and 4.9°C temperature anomaly. I projected to year 2055 at 1km resolution using the CSIRO Mark 3.0 Global Circulation Model. As these were simple models (i.e. I did not include environmental predictors such as soil or ridgetop characteristics), processing time from commencement of data cleaning to secondary model output was < 3 hours.

Range contractions under business as usual carbon emissions

Random Forest performed acceptably to excellent for the species distribution models with accuracy ranging from 63% to 99%. Species with more occurrence records (> 100) generally had higher model accuracy. All species were predicted to have current suitable habitat extending into the Victorian Alps and Tasmanian high country. Mean temperature of the warmest quarter (B10) and annual precipitation (B12) were the two most important climatic predictors, followed by isothermality (B03) and precipitation seasonality (B15). As isothermality (B03), temperature seasonality (B04) and temperature annual range (B07) co-vary, removing the latter two predictors would refine the model.

All nineteen species were predicted to experience significant contraction of suitable habitat and decreased probability of occupancy under RCP 8.5 by 2055. Change in the centre of species' ranges was predicted to shift southward between 13 to 55 km. Some species (*Brachyscome stolonifera, Cardamine robusta, Dichosciadium ranunculaceum* var. *ranunculaceum*, *Euphrasia collina* subsp. *glacialis, Pappochroma setosum* (syn. *Erigeron setosus*), *Ranunculus anemoneus, Chionochloa frigida*) were predicted to still have suitable habitat within their current range but only at the highest elevations of the Snowy Mountains, with a decreased probability of occupancy on lower-elevation range margins (Figure 2). Interestingly, these are all species that occupy wetter microhabitats, reinforcing that the inclusion of climatic and environmental layers that consider moisture availability is important in alpine environments, and suggesting a possibility that model projections could be improved in relation to climate refuges with fine-resolution soil moisture data (Ashcroft *et al.* 2012, Lembrechts *et al.* 2019).

Two of the nineteen species, *Astelia psychrocharis* and *Craspedia costiniana*, model accuracy 66.2% and 67.4%, respectively, were predicted to experience some expansion in future suitable habitat relative to their current distribution. *Astelia psychrocharis* inhabits wet situations in the alpine and subalpine and is locally common in its current range. While *A. psychrocharis* does not currently extend into Victoria, suitable habitat on the Bogong High Plains was reflected in a 1% (6.9 km^2) predicted range expansion by 2055. I am cautious to agree with the predicted northerly range expansion for *C. costiniana* due to uncertainty in a subset of occurrence points fed into the primary experiment. This serves as an important reminder that meticulous data cleaning is essential if the goal is to generate reliable species distribution models and climate change projections.

Suitable habitat of the ten remaining species (*Colobanthus nivicola*, *Craspedia leucantha*, *Euphrasia collina* subsp. *lapidosa*, *Euphrasia alsa*, *Gentianella muelleriana* subsp. *alpestris*, *Gingidia algens*, *Nematolepis ovatifolia*, *Ranunculus acrophilus*, *Ranunculus dissectifolius, Ranunculus niphophilus*) was projected to completely contract from the Snowy Mountains alpine region under RCP 8.5 by 2055 (Figure 3).

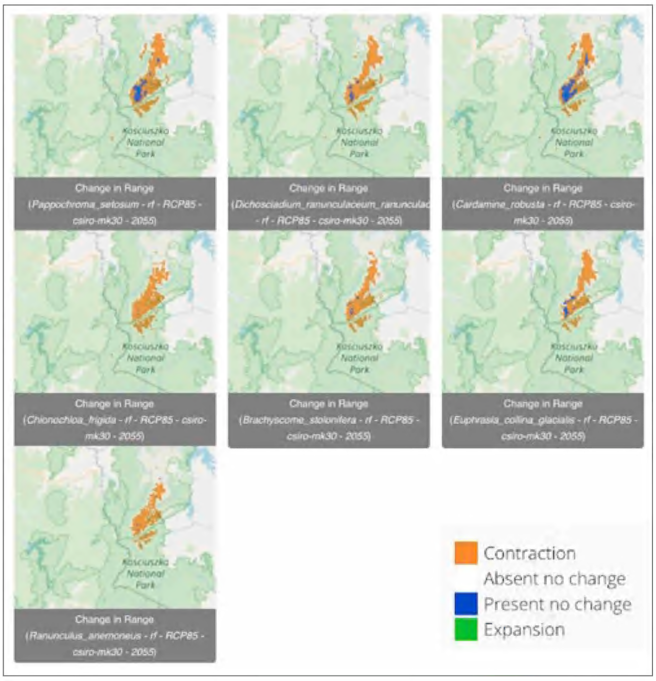
Kosciuszko National Park
Change in Range (Pappochroma_setosum - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Dichosciadium_ranunculaceum_ranunculac - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Cardamine_robusta - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Chionochloa_frigida - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Brachyscome_stolonifera - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Euphrasia_collina_glacialis - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Ranunculus_anemoneus - rf - RCP85 - csiro-mk30 - 2055)
Contraction
Absent no change
Present no change
Expansion

Figure 2. Primarily range contraction with some range retention. Seven species that are predicted to maintain suitable habitat within their present range under RCP 8.5 by 2055.

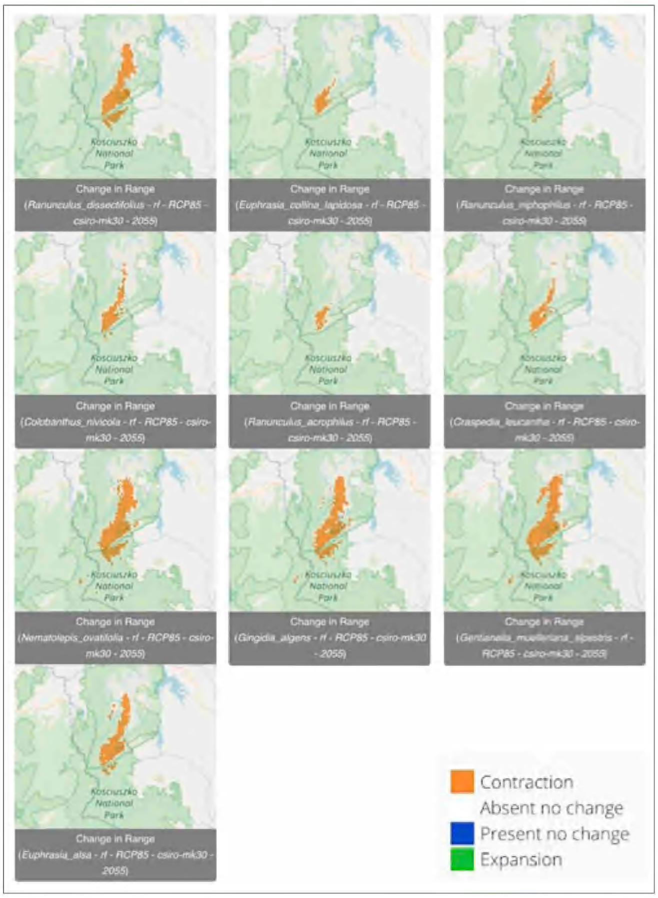
Kosciuszko National Park
Change in Range (Ranunculus_dissectifolius - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Euphrasia_collina_lapidosa - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Ranunculus_niphophilus - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Colobanthus_nivicola - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Ranunculus_acrophilus - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Craspedia_leucantha - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Nematolepis_ovatifolia - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Gingidia_algens - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Gentianella_muelleriana_alpestris - rf - RCP85 - csiro-mk30 - 2055)
Change in Range (Euphrasia_alsa - rf - RCP85 - csiro-mk30 - 2055)
🟧 Contraction
Absent no change
🟦 Present no change
🟩 Expansion

Figure 3. Complete range contraction. Ten species are predicted to experience complete loss of suitable habitat in the Snowy Mountains under RCP 8.5 by 2055.

Conservation implications

This case study demonstrates that climatic conditions in which the Snowy Mountains alpine endemic species are currently found, or where they have been found in the recent past, will largely shift away from this region in the next 30 years under the 'business as usual' carbon emission scenario. The ten species predicted to experience complete range contraction may be good candidates for future monitoring and potentially for *ex situ* conservation investment.

It is important to note that these species have a diversity of life histories, and have been present in the Kosciuszko alpine environment for tens of thousands of years (Venn *et al.* 2017). Microhabitat heterogeneity occurs over such fine scales in the alpine that horizontal migration of just tens of meters may be sufficient for some species to persist *in situ* as the surrounding environment warms (Scherrer & Körner 2011). Improving primary models with a greater number of spatially accurate occurrence records, along with tailored, species-specific environmental and climatic predictors, is a useful next step in refining model outputs.

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Cryostorage of Australian rainforest species

LYNDLE K. HARDSTAFF[1,2], KAREN D. SOMMERVILLE[2], BRYN FUNNEKOTTER[1,3], ERIC BUNN[3], CATHERINE A. OFFORD[2] AND RICARDO L. MANCERA[1*]

[1] School of Pharmacy and Biomedical Sciences, Curtin University, WA.
[2] Royal Botanic Gardens and Domain Trust, NSW.
[3] Kings Park Science, Department of Biodiversity, Conservation and Attractions, WA.
[*] Corresponding author: R.Mancera@curtin.edu.au

Conservation in *ex situ* collections is vital to the survival of many threatened plant species. Living collections, such as those in botanic gardens, are an important part of such conservation. However, these collections are subject to constraints such as available space and growing conditions, which may limit the number of individuals and genotypes conserved. Longer-term conservation of a greater diversity of genotypes is essential to guarantee the persistence of species.

Seed banking is one such popular and efficient method for long-term plant conservation. Seeds are usually dried to 3-7% moisture content and stored at or below 18°C for short-term storage, or -20°C for long-term storage. These conditions have been found to increase longevity of seeds in storage by reducing metabolic activity and inducing dormancy (FAO 2014). However, estimates suggest that around 8% of plant species have seeds that cannot survive in these storage conditions, including many Australian rainforest species (Wyse and Dickie 2017). Issues such as desiccation sensitivity, cold sensitivity, short life span, and higher metabolic rate prevent the seeds of these species from being stored in a seed bank (Kaczmarczyk 2012).

Cryostorage

Cryostorage provides a potential solution for the conservation of species which cannot be stored in a seed bank. This method allows plant material to be 'snap frozen' in liquid nitrogen, thus stopping metabolic processes and preventing ageing of material in storage (FAO 2014). There are several steps in a cryostorage protocol (Figure 1), each of which needs to be optimised for individual species to achieve successful cryostorage and retrieval (Berjak and Pammenter 2014).

1. Firstly, very small pieces of material (1-5 mm^3) are excised from the plant, usually from seed or shoot tips. Inclusion of root and/or shoot tip meristematic tissue is preferred.
2. These explants are then desiccated by either airflow or osmosis; using liquid or solid tissue culture media containing high concentrations of sugars. It is important to reduce the amount of free water present in cells that may form damaging ice crystals during cooling and re-warming.

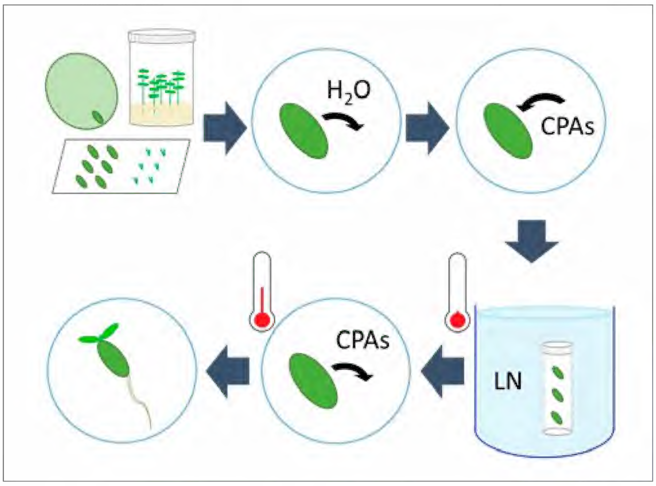

Figure 1. General steps of a cryostorage protocol (clockwise, from top left): explant excision, desiccation, application of cryoprotective agents (CPAs), rapid cooling in liquid nitrogen (LN), re-warming and washing off CPAs, recovery and growth on tissue culture media.

3. Cryoprotective agents (CPAs) are then applied to the explants as an 'anti-freeze' and replace water in cells in order to maintain cell integrity.
4. Explants are rapidly cooled by submersion in liquid nitrogen (LN) at -196°C.
5. Stored explants are recovered by rapid re-warming to reduce time spent in the temperature range at which ice crystals may form. CPAs are washed off to reduce toxicity.
6. Explants are sown on tissue culture media to recover, initially in the dark to prevent photo-oxidative stress. Plantlets are moved into the light when they have begun to grow roots and shoots.

An advantage of cryostorage is the ability to store more diverse germplasm types, in comparison with traditional seed banking. In addition to seeds, embryos (or part thereof), shoot tips and other vegetative material, callus, and pollen have all been stored successfully in liquid nitrogen. This is particularly useful for the conservation of species that do not produce sufficient seed for seed-banking, such as rare species and those affected by poor climatic conditions or disease.

Myrtle rust (*Austropuccinia psidii*), for example, is known to cause dieback of growing fruits of the critically endangered scrub turpentine (*Rhodamnia rubescens*) and native guava (*Rhodomyrtus psidioides*) (Carnegie 2016). Use of different germplasm types in cryostorage of Australian plant species is reviewed in Streczynski *et al.* (2019).

Study species

Rainforest habitats are increasingly under threat worldwide and are also more likely to include plant species with seeds that cannot be stored in a seed bank. As such, this study aims to develop cryostorage protocols for a number of eastern Australian rainforest species (Figure 2). The selected species have seeds with a range of desiccation and cold tolerances, for comparison purposes, and include threatened and socio-economically important species. For example, wild-type and cultivated macadamia (*Macadamia integrifolia*); bunya pine (*Araucaria bidwillii*) and other Araucariaceae; lemon myrtle (*Backhousia citriodora*), scrub turpentine (*R. rubescens*), and other Myrtaceae species (including *Syzygium australe* and *S. paniculatum*) which are popular in cultivation.

A collaborative research program is being conducted at the Australian PlantBank (Australian Botanic Garden Mount Annan) with Western Australian research partners Curtin University and Kings Park Science (Department of Biodiversity, Conservation and Attractions).

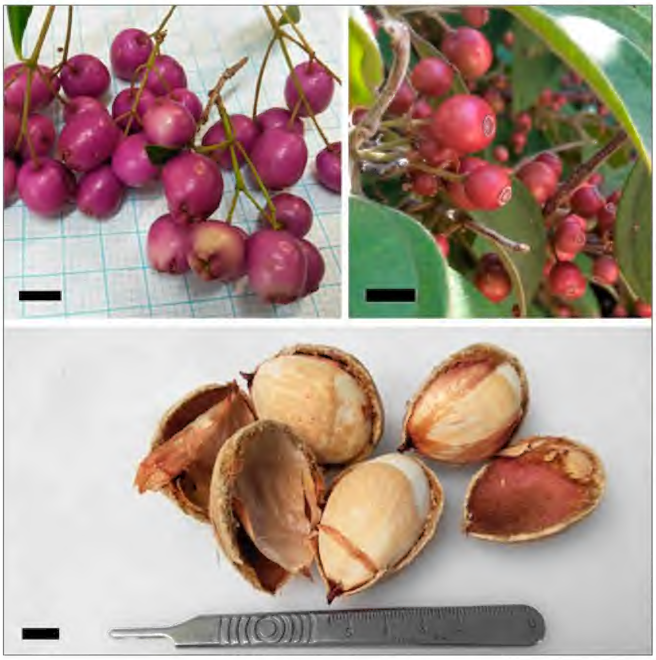

Figure 2. Examples of eastern Australian rainforest species targeted for development of cryostorage protocols. Top left: collected fruit of magenta lilly pilly (*Syzygium paniculatum*); top right: immature scrub turpentine (*Rhodamnia rubescens*) fruit growing on a healthy plant; bottom: bunya pine (*Araucaria bidwillii*) seeds with opened seed coats. Scale bar = 1 cm. Photo: L. Hardstaff

Preliminary results

Tissue culture

Four species have been initiated into tissue culture to produce shoot tips for cryostorage experiments. *Syzygium anisatum*, *S. australe* and *S. paniculatum* multiplied well and produced sufficient shoot tips to begin experimentation. Two cultivars of *M. integrifolia* ('Beaumont' and 'Own Choice') were initiated from cuttings of young seedlings and have been much slower to multiply, with only 1-12 plantlets produced from each of the surviving cuttings (Figure 3).

More experimentation is required for the successful initiation of other species into tissue culture, particularly as it is a vital step in the recovery of material from cryostorage. Some species grown from embryonic axis have survived but failed to multiply after a year in culture, while others have produced only miniaturised plantlets. Many *A. bidwillii* embryos have produced roots in tissue culture but only one embryo produced a shoot tip, which did not survive.

Cryostorage

Preliminary cryostorage results are promising, with good survival of explants after exposure to cryostorage pre-treatments (step 2-3; Figure 1). There has been less survival after storage in LN, however, and further experimentation is required.

Embryonic axes of both *M. integrifolia* cultivars have survived pre-treatments, though continued growth one month after treatment has been limited. Six months after pre-treatment, only a few individuals have produced true leaves (Figure 4). Limited survival was seen in *M. integrifolia* embryonic axes and *A. bidwillii* partial embryos after storage in LN, with most surviving explants only producing callus (undifferentiated cell growth). Some *M. integrifolia* axes have also produced shoot buds.

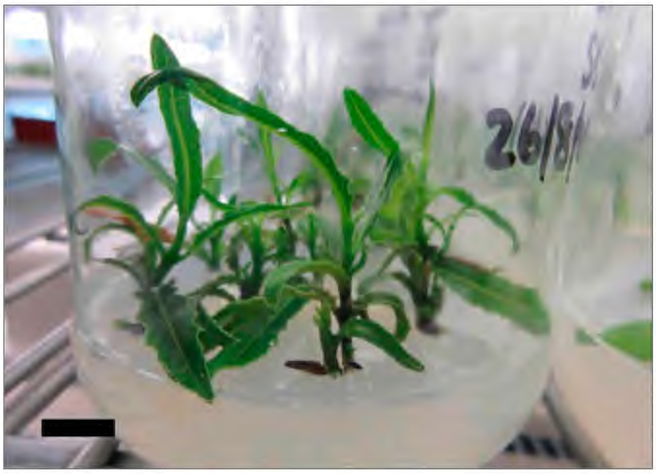

Figure 3. One-year-old *Macadamia integrifolia* 'Beaumont' plantlets grown from a single cutting in tissue culture. Scale bar = 1 cm. Photo: L. Hardstaff

Embryos of *S. anisatum* also survived pre-treatments, producing roots and true leaves within weeks of exposure, but did not survive storage in LN. Seeds of *B. citriodora* have been the most successful to date, with a number producing roots and leaves within weeks of pre-treatment and storage in LN.

Future experiments will focus on optimisation of each cryostorage step to improve survival.

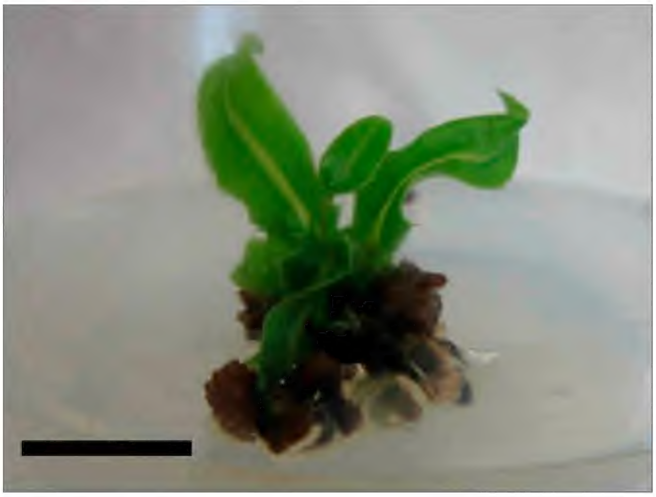

Figure 4. ***Macadamia integrifolia*** **'Beaumont' plantlet grown from embryonic axis in tissue culture, 6 months after treatment with cryoprotective agents. Brown tissue is callus (undifferentiated cell growth). Scale bar = 1 cm. Photo: L. Hardstaff**

Acknowledgements

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Moving threatened plants: story and practice

CHANTELLE DOYLE* AND MARK OOI

Centre for Ecosystem Sciences, School of Biological Earth and Environmental Sciences, University of New South Wales, Sydney, Australia
*Corresponding author: chantelle.doyle@student.unsw.edu.au

The question

Using mixed methods research, we commenced a study asking the question: is translocation of threatened plants a viable conservation and/or mitigation measure?

Your initial reaction might be that this question is unreasonable. Conducting a translocation relies on multiple factors: location, time, cost, the species and its ecology, type of translocation, number of propagules, relatedness, and propagule type. Translocation is a simple word, representing a simple physical action which belies its potential complexity. Defined as movement or direct transport of plant material from one area to another (Commander 2018) the term does not immediately capture the many perspectives of practitioners and their motivations, nor convey that practitioners are drawn from diverse and varied fields. Answering this question then is also subjective and dependent on intentions and expectations.

Why is it relevant?

Although there have been reviews into translocation (Falk *et al.* 1996; Gallagher *et al.* 2015; Godefroid *et al.* 2016; Godefroid *et al.* 2011; Hancock *et al.* 2014) and guidelines are in place to inform planning and preparation (Commander 2018; IUCN 2013; Maschinski *et al.* 2017), these are not intended to represent the subjective experiences of practitioners, per se, despite the inclusion and even dedicated production of valuable case studies (e.g. IUCN Global Reintroduction Perspective series). Nor are outcomes of translocations often in formats suitable for the various practitioner groups (e.g. consultants, researchers, policy makers, community volunteers, developers). Similarly, they are rarely communicated in a way that directly portrays the complexities (and realities) of stakeholder relationships, budgets, legislative requirements and timelines. Thanks to the work of Silcock *et al.* (2019), we know that of 1,001 translocations documented in Australia only 109 have been published in peer reviewed literature. Of those, how many require paid subscriptions that may be inaccessible to non-academic audiences? How many others have been published in grey literature (e.g. consultant reports to developers), accessible in theory, but practically mired in red tape and 'client confidentiality.'

Given that translocation practice has doubled in Australia since 2010 (Silcock *et al.* 2019) and will surely continue to rise under pressures of urbanisation and increasingly population, conserving threatened flora will rely on iterative and shared learning. Certainly, it is important to understand what has worked, but of equal importance to learning how to successfully translocate is an understanding of the challenges, limitations, setbacks and outright failures, and how these were navigated. Planning for a best practice translocation also requires, where possible, a thorough estimate of necessary resources (labour and cost), time requirements, as well as an adequate understanding of the target species' ecology and potential ecological limitations to establishment of a long-term self-sustaining population, if self-sustaining is the agreed definition of success (Menges 2008; Monks *et al.* 2012).

What research is being conducted?

Using qualitative and quantitative research, our project uses personal as well as practitioner experience to critique practical requirements of best practice translocations and draw (some) conclusions about its viability. Specifically, we aim to identify:

1. Translocation requirements of a critically endangered case study species, *Hibbertia spanantha*, including propagation methods which increase establishment and reproductive success.
2. Timelines, resources and cost requirements (including in-kind) of a best practice translocation including understanding of species ecology and population genetics.
3. Practitioner experiences in and opinions of translocation practice.

Please contact the corresponding author if you would like to know more about the first two points listed above. To date, we have conducted two translocations, as well as performed manual hand pollinations, counted thousands of buds and flowers, monitored for pollinators (Figures 1 and 2) and commenced interrogating the genetic health and relatedness between and within known populations.

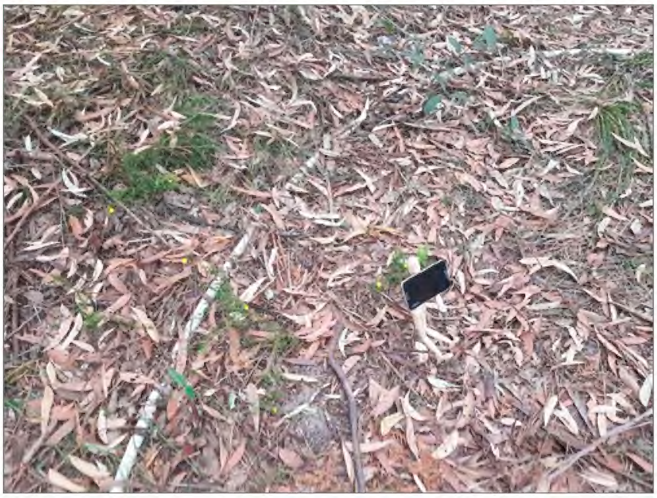

Figure 1. Camera trap monitoring of insect visits to *Hibbertia spanantha* (with mobile phone and mannequin). Photo: Chantelle Doyle

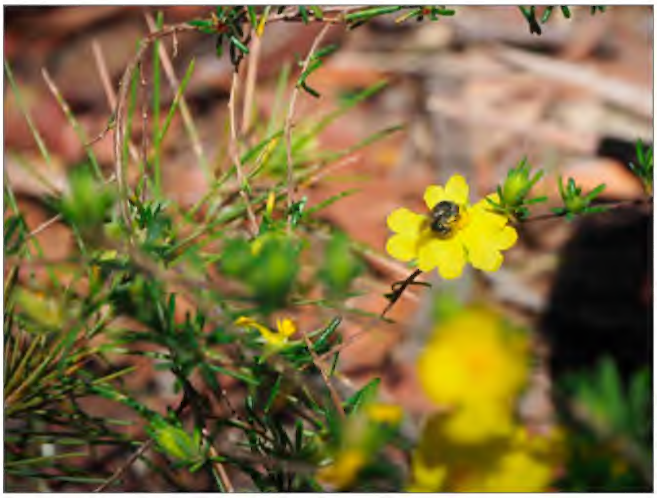

Figure 2. Visiting *Lasioglossum (Chilalictus)* on *Hibbertia spanantha*. Photo: Chantelle Doyle

Regarding the third aim, our study does not attempt to review literature or translocation metrics (this has been undertaken by various authors already cited) but rather to combine the opinions of practitioners into several threads, including:

a. A review of trends between individual experiences and projects.

b. An analysis of some of the most commonly shared perspectives.

c. A relevant, accessible and interesting product which will complement existing guidelines (Commander 2018; Maschinski *et al.* 2017) and can be shared between different stakeholders working in both conservation and mitigation translocation.

Get involved!

Under the guidance of supervisors Dr Mark Ooi (UNSW), Dr Georgie Garrad (Royal Melbourne Institute of Technology, RMIT) and Dr Jenny Martin (University of Melbourne) and with support of many people around Australia, we will be producing a series of podcasts and videos (Figure 3) showcasing translocation in Australia. We invite you to share your experiences, particularly if you have partnered with community groups or industry.

What happened? Who was involved? What did you do when the inevitable challenges hit? What would you do differently next time? What parts made you laugh and what parts made you sit back, sigh, and say, “that was rewarding”.

It is our hope that these podcasts and videos will provide a novel communication tool to help inform effective decision making about the appropriateness of translocation as a conservation or mitigation action (Germano *et al.* 2015). Open accessibility will also mean that the podcast and accompanying video series can be used as an introductory platform for non-academic audiences, such as developers, mining companies and legislators. This research will also give voice to the many individuals and teams that donate countless hours to conservation and whose efforts are often critical to maintaining and monitoring translocated populations.

If you would like to know more, or think you have a story to tell, please get in touch.

Figure 3. Filming for case study of *Allocasuarina portuensis* translocation project. Pictured Mark Viler (Australian Botanic Garden Mount Annan and videographer Michael Lawrence-Taylor). Photo: Chantelle Doyle

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Threatened plant translocation case study:

Persoonia hirsuta (Hairy Persoonia), Proteaceae

SAMANTHA E. ANDRES[1,2,*], NATHAN J. EMERY[2], DAVID GREGORY[3] AND JEFF POWELL[1]

[1] Hawkesbury Institute for the Environment, NSW.
[2] Royal Botanic Gardens & Domain Trust, NSW.
[3] Illawarra Coal, Appin, NSW.
*corresponding author: s.andres@westernsydney.edu.au

The species

- Long-lived perennial shrub.
- Listed as Endangered under:
    - New South Wales *Biodiversity Conservation Act 2016* (BC Act).
    - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Endemic to the Sydney Basin, NSW.
- Early divergent lineage of the Proteaceae; lacks cluster roots.
- Only 300-400 individuals in the landscape.

Threatening processes

- Mostly small isolated populations or individual plants (most <10 plants).
- Habitat fragmentation and loss.
- Observed dieback by unknown cause(s).
- Large fragmented habitat patches between populations.
- Poor seed set and lack of recruitment *in situ*.

Deciding to translocate

Historic surveys and herbarium records of *Persoonia hirsuta* noted over 600 individuals to occur throughout its known distribution. Due to recent urbanisation and increased development pressures throughout Sydney, this species is experiencing significant decline. Efforts to conserve *P. hirsuta* in the landscape have been hampered by observed dieback from an unknown cause. Additionally, efforts to conserve the species *ex situ* have been negatively affected by issues associated with microbial contamination, resulting in low recruitment success (Emery and Offord, 2019). *P. hirsuta* is listed as Endangered under the EPBC Act and NSW BC Act. This species is found in dry sclerophyll open forests and heathlands of sandstone origin, often in areas of mild disturbance with an open canopy (Figure 1). While the Sydney Sandstone ecosystem in which *P. hirsuta* is found is relatively common, there are several ecological factors related to this species' biology that contribute to its rarity in the landscape (outlined in 'Threatening Processes' above). In addition, the genus lacks a cluster root system, common to most other species in the Proteaceae, and it is hypothesised that a missing fungal or microbial biological link may have been overlooked. Cluster roots help Proteaceous plants uptake phosphorous from the soil through fine hairs that increase the surface area to aid in water absorption. Furthermore, *P. hirsuta* might be susceptible to soil pathogens, which could also explain the observed dieback in the landscape. Further exploration of the presence and functional importance of soil organisms in association with *P. hirsuta* will greatly improve our understanding of the below-ground ecology of this genus.

Aim of the translocation

The aim of this experimental translocation trial was to examine the growth and survival of translocants from different *ex situ* propagation methods under several *in situ* translocation techniques. The investigation also examined whether the recipient site soil might influence plant survival. This will be further assessed through pre-and post-translocation soil sampling to quantify changes in biotic and abiotic soil factors. In conjunction with the soil sampling at the translocation site, extensive soil sampling is also being conducted throughout the species' distribution to further augment our understanding of the soil biology for this species and help refine future conservation efforts.

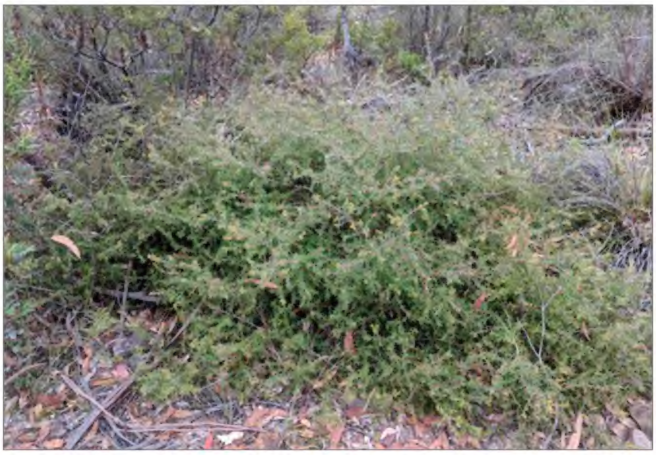

Figure 1. A mature *Persoonia hirsuta* shrub amongst dry sclerophyll woodland vegetation. Photo: Nathan Emery

Translocation working group and key stakeholders

An overview of key stakeholder's responsibilities, contributions and commitments to the project is outlined in the following table:

	Oversee and conduct soil sampling	Oversee and conduct landscape sampling	Development of the experimental design	Regular translocation monitoring	Supply plants for the translocation with traceable genetic lineages	Provide funding and support for the Project	Upkeep of the site and regular watering	Providing site access and assistance on site
Hawkesbury Institute for the Environment (WSU)	x	x	x	x				
Australian Botanic Garden Mount Annan (ABGMA)			x	x	x			
Illawarra Coal (South32)				x		x	x	x

Biology and Ecology

- Long-lived species – adults may survive up to 30 years.
- Common to many Proteaceae species, P. *hirsuta* has a very low flower to fruit ratio, and most *Persoonia* species are obligate out-crossers (Emery and Offord 2018, Rymer *et al.* 2005).
- Native bees have been observed to pollinate *P. hirsuta* flowers (Figure 2), including Green Carpenter bees (*Xylocopa* sp.), *Leioproctus* spp., Yellow-spotted Masked bee (*Hylaeus* sp.) Fire-tailed Resin bee (*Megachile* sp.), *Tetragonula carbonaria*, and Blue-banded bees (*Amegilla* sp.), and pollinator visitation may be influenced by *P. hirsuta* population size.
- Physical disturbance may promote germination and improve seedling establishment as a high proportion of plants are commonly found in disturbed areas along roadsides and tracks where competition for light is low.
- Assumed persistent seedbank with two types of dormancy associated with the pyrene (i.e. seed + endocarp):
  - Mechanical dormancy: a woody endocarp around the seed, restricts germination until the endocarp is manually removed or breaks down naturally over time.
  - Physiological dormancy: within the embryo of the seed often requiring specific environmental conditions (i.e. temperature) in order for germination to commence.
- Fruits are commonly consumed by macropods and small birds (Emery and Offord, 2018).

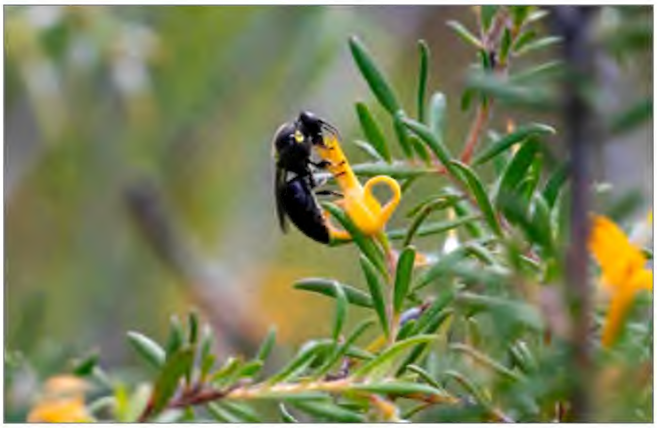

Figure 2. ***Persoonia hirsuta*** **flower being pollinated by a Yellow Spotted Masked Bee. Photo: Nathan Emery**

Site selection

The current translocation forms part of a larger mining restoration program with the recipient site located within an environmental offset area at South32 Illawarra Metallurgical Coal's (S32IMC) Appin North site. The site is an open shrubby woodland swale, with considerably sandy soil, characterized by *Banksia ericafolia, Petrophile sessilis, Leptospermum trinervium, Leucopogon esquamatus Boronia ledifolia* and *Isopogon anemonifolius*. The area is also a management site under the Department of Planning, Industry and Environment (DPIE) *Saving our Species* (SOS) program for *P. hirsuta*. The translocation design involved the planting of 128 individuals in the offset area where the core extant *P. hirsuta* population currently exists. The translocation area is 300m^2 with plants positioned evenly throughout smaller blocks within the area.

Translocation proposal

The translocation plan was first drafted by ABGMA and S32IMC using the ANPC's Translocation Guidelines (Commander *et al.* 2018). This research is also being undertaken to satisfy S32IMC's mine approval conditions under the EPBC and EP&A Acts. This translocation plan has also been provided to DPIE. The translocation commenced in May of 2019.

Pre-translocation preparation, design, implementation and ongoing maintenance

Vegetative cuttings and fruits used in this translocation were sourced and propagated in 2017 and 2018, respectively. Fruits and cuttings were collected from extant plants around S32IMC's Appin North mine, and a fruit collection was also made at a population from Glenorie, northwest of Sydney. Vegetative cuttings were also collected from a large population at Yanderra, south of Sydney. Planting treatments were assigned within the translocation site using a randomized block design (16 blocks within) to account for the potential variability across the site and produce a better estimate of the effects of each treatment. Four treatments (control, local mulching, plant guard, local mulching + plant guard) were applied to the seedlings and cuttings giving a total of eight treatments (Figure 3). Mulch was collected from the surrounding area where a planting hole was dug, and then applied around the base stem of the translocant after it was planted. Plant guards were erected using three bamboo sticks stakes and a hessian bag. Within each of the 16 blocks, treatments were randomly assigned to ensure that both plants and treatments were randomly distributed throughout the plot. Individual holes were dug 24 hours prior to planting, and the translocants were hand-planted according to the experimental design. Tools used to dig the holes were sterilised with 70% ethanol between blocks. Soil from each hole was subsampled by block for DNA and nutrient analyses.

Table 1. Subjective scoring system for recording visual observations of dieback in *P. hirsuta*.

Presence of Dieback	
Dieback Rating	**Description**
5	Near death or dead
4	Severe defoliation/browning of leaves
3	Some defoliation/yellow-brown leaves
2	Few signs of defoliation/green-yellow leaves
1	Green-yellow leaves or better

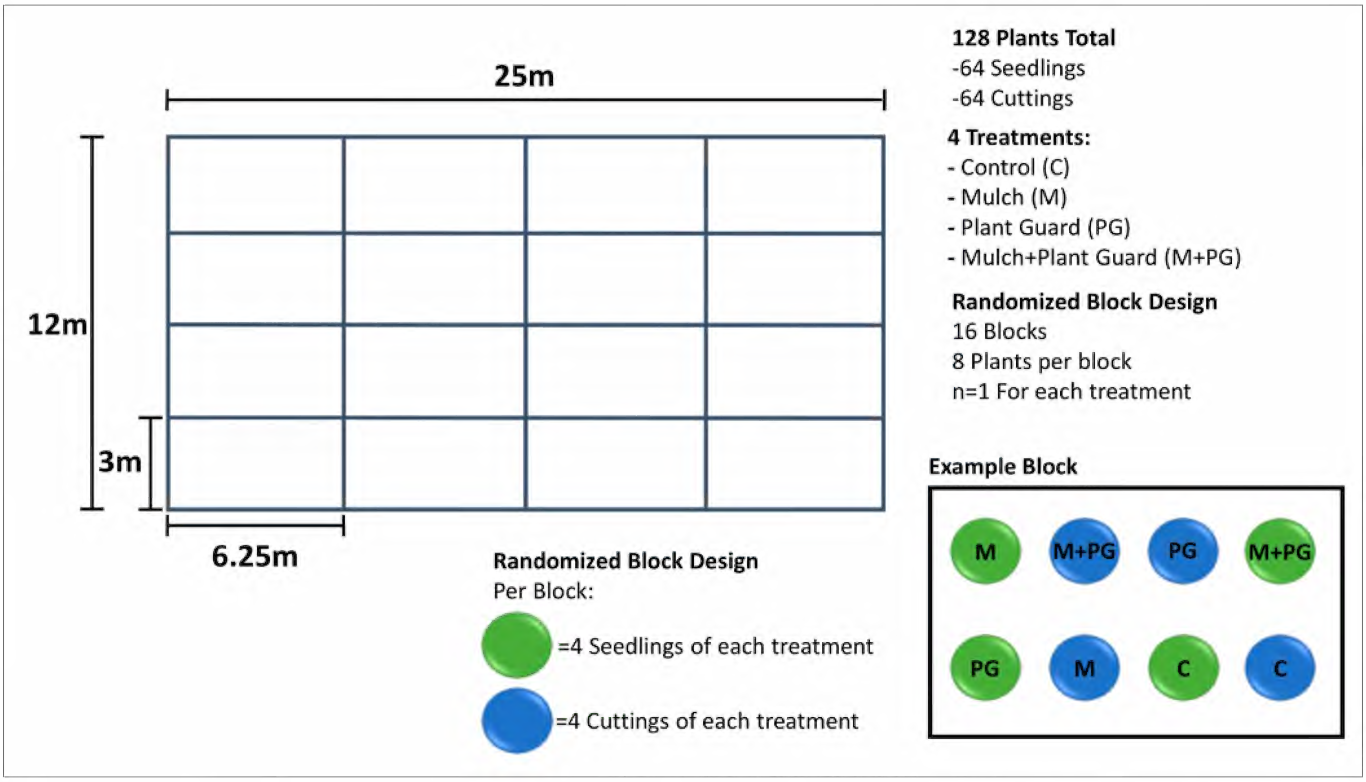

Figure 3. Plot layout and design for the randomized block design. Seedlings (green), cuttings (blue), and treatments applied to each, and randomly distributed among blocks.

Subsequent actions

All plants will receive around 1L of water per week for the first 12 months, except during prolonged periods of rain. For the first 12-24 months the primary objective of post-translocation monitoring will be to assess plant survival and growth. Detailed measurements of plant height, branch number, herbivory evidence, and dieback (Table 1) are being monitored monthly. Camera traps have also been placed throughout the site to document herbivory. Once the plants reach reproductive maturity, flowering and fruiting rates will also be recorded. Twelve-months post-translocation (i.e. May 2020), repeat soil sampling will be conducted to assess any changes in the abiotic conditions or soil community post-translocation. Regular maintenance at the site also includes fixing plant guards and adding additional mulch to the mulch treatments.

Outcomes

Despite evidence of dieback and significant herbivory in some plants, survival is 100% (as of December 2019). Translocants protected by plant guards have the lowest observable dieback, as herbivory by swamp wallabies (*Wallabia bicolor*) has been high. Several plants propagated from cuttings flowered in late spring.

What we will learn

This research will contribute valuable information to the federally-approved conservation advice and recovery plan for *Persoonia hirsuta*. This work will also align with the ongoing *Persoonia* Conservation Research Program at ABGMA. In addition, this research will contribute to the aims and objectives of the SOS program and inform future conservation management practices for S32IMC. Further exploration of the relationship between *P. hirsuta* and its microbial community will contribute valuable information to the evolutionary history of this family, and practical management of members in this genus.

Finally, this work will back the ongoing research regarding plant-soil interactions, specifically relating to those associated with rare plants. With the continuation of regular monitoring at the site and soil analyses both on site and in the landscape, we hope to further our understanding of the ecology of *Persoonia* species *in situ* and address the presence and potential agents of dieback in the landscape.

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Check those IDs: the importance of confirming threatened plant identifications before implementing management

STEPHEN BELL

School of Environmental and Life Sciences, University of Newcastle, NSW.

Corresponding author: stephen.bell@newcastle.edu.au

Many threatened plant species are the subject of dedicated and specific management actions to assist in redressing population declines due to anthropogenic disturbances. In some circumstances, threatened taxa may occupy naturally highly restricted geographical ranges which may or may not be directly impacted upon by human actions. Often, management of all such taxa is constrained by lack of knowledge on basic information traits such as distribution, ecology, pollinator interactions, seed dispersal and threats. Frequently, an initial step undertaken at the commencement of any management program is to audit known records of a taxon and identify suitable sites and actions that can be implemented. Online observation databases are a common tool for this purpose, but most practitioners are cautious in automatically accepting these records at face value, knowing that many held there often require verification.

But what of those records where voucher specimens have been lodged at recognised herbaria – do we ever question those? Surely the presence of a voucher specimen indicates that it is a 'good' record? Prior to outlaying often significant amounts of funding for management, should we be double-checking every population that we intend to manage, even when there are vouchered and catalogued specimens? Recent experience in central eastern New South Wales with two highly restricted endemics suggests that yes, we should always double-check before preparing plans to manage a threatened plant.

Pomaderris reperta (Denman Pomaderris)

Pomaderris reperta (Figure 1) is listed as critically endangered on the NSW *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Walsh and Coates (1997) described this species as a narrow endemic of the Denman area in the upper Hunter Valley, known only from its type location. Subsequent searches in the wider area over the last two decades have uncovered a small number of additional stands, but the species remains highly restricted to a few locations near Denman. *P. reperta* is also currently the subject of a NSW Government Saving our Species (SOS) project at two localities.

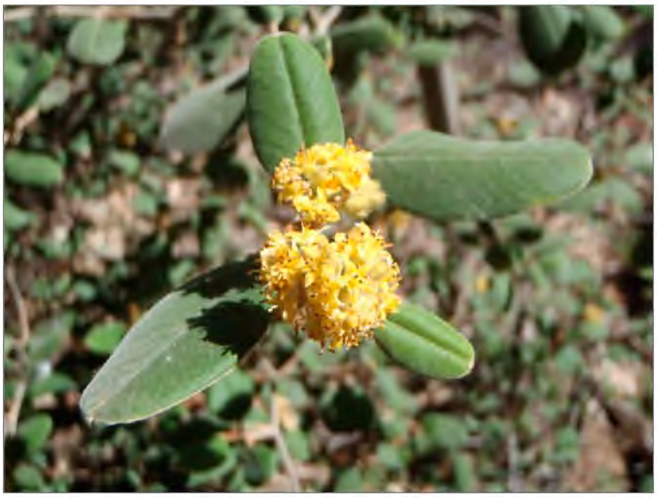

Figure 1. Flowering specimen of *Pomaderris reperta*. The notched apex of adult leaves is a useful identification tool, but this may also be present in *P. cotoneaster*.

In 2018, surveys conducted for a proposed wind farm south of Mudgee, approximately 100 km south-west from Denman, purportedly discovered a new population of *Pomaderris reperta*. The consultant botanists involved followed the correct procedures, lodging material for confirmation at the National Herbarium of NSW, which returned positive for *P. reperta*. Evidently, a prior collection from that same locality had been independently lodged by a passing botanist at that same herbarium and determined as *P. reperta* in 2013. Two independent collections five years apart, each confirmed by a recognised herbarium, suggested a validated third population of the species had been found.

As a pre-cursor to potentially adding a third management site to the SOS program, a site visit was organised in January 2019 to investigate its potential for active management and to generate an indicative budget for achievable tasks. What eventuated, however, was a serious questioning of the identity of the new population, and ultimately a re-determination of the stand not as *P. reperta* but of *P. cotoneaster*, itself a threatened species from southern New South Wales. Apart from morphological differences between the Denman and Mudgee plants, there were also considerable discrepancies in habitat between the two sites, involving geology, soil, climate and floristic associates. Consequently, Denman remains the only known area supporting this taxon.

Lasiopetalum longistamineum (Mt Dangar Velvet-bush)

Lasiopetalum longistamineum (Figure 2) similarly occupies a highly restricted distribution near Mt Dangar in the upper Hunter Valley. This taxon is listed as vulnerable in both the BC Act and the EPBC Act, and it too is subject to management at two sites under the SOS program. Historically, collections of *L. longistamineum* have only been made from the gullies and slopes around Mt Dangar, where it typically grows in enriched soils derived from basalt or Narrabeen sandstone material, almost always associated with protected gullies.

During targeted threatened species surveys conducted on the Singleton Military Area (SMA) in 2004, some 80 km south-east of Mt Dangar, three individuals of a species tentatively identified as *Lasiopetalum longistaminuem* were located within a dry open forest on Permian conglomerate and claystones. An absence of fertile material meant that the original collector could not be certain of the identification, and indeed collection notes associated with the specimen stated, "*leaf morphology fits* L. longistamineum *but fertile material is required to confirm identification*". On the strength of this collection, the Department of Defence rightly erected a fence around the three plants to protect the area until confirmation could be achieved. This action, however, inadvertently led to the assumption by subsequent workers that those three plants were indeed *L. longistamineum*, and hence were used as a reference population for further surveys. Later surveys then apparently discovered an additional two populations of the taxon nearby, comprising between 2,200 and 2,750 individuals.

Once again, with a view to establishing an additional management site that could be used to bolster the two existing SOS sites, an inspection of the SMA in 2019 revealed populations of the widespread and common *Lasiopetalum ferrugineum*, not *L. longistamineum*. Inspected plants from all known populations on the SMA, although still in bud, did not display either of the traits that distinguishes the threatened taxa from its more common congener, *viz* flowers crowded in spike-like branches, and elongated stamen filaments. For 15 years there had been a presumption that the SMA supported an important and disjunct population of *L. longistaminum*, all based on a 2004 collection only tentatively identified as this taxon. Recognising the disjunct nature of the SMA from Mt Dangar, and the widely differing habitats occupied (dry open forest on older sediments vs protected gullies on younger enriched soils), the first step of verifying identity eliminated the need for funding to establish a third SOS site here. *L. longistamineum* remains restricted to the Mt Dangar locality.

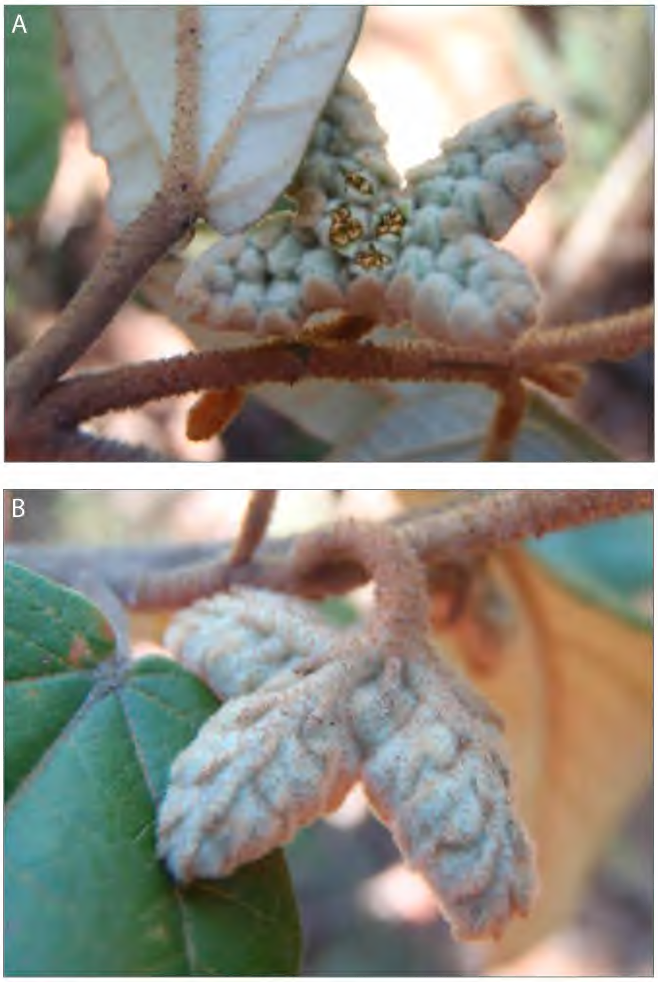

Figure 2. Lower (A) and upper (B) view of the characteristic cymes of *Lasiopetalum longistamineum*, showing starfish-like arms each bearing 4-8 flowers.

Conclusion

Practicing botanists are heavily reliant on herbaria and expert taxonomists to assist in the confirmation of plant specimens, and this is particularly important when the fate of threatened plant species and their management depends on consistent and accurate advice. Despite the presence of voucher specimens in these two cases, mistaken identities in their determinations potentially resulted in the erroneous allocation of funds and resources where these were not warranted. This is concerning when conservation dollars are stretched across a wide range of threatened taxa, and the misapplication of funds may have dire consequences for other taxa. More worrying is the continual decline in the perceived value of herbaria and taxonomists across the country (see Taxonomy Decadal Plan Working Group 2018), resulting in fewer full-time taxonomists and identifications staff that are poorly resourced and operate under considerable stress. With this in mind, and in this era of data-basing and on-demand information, it is imperative that botanists working with threatened species remain diligent in their identification of target species, and to not be afraid to investigate further the validity of databased information.

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Acknowledgements

Thanks to Neville Walsh and Lachlan Copeland for assistance in unravelled identification issues for *Pomaderris* and *Lasiopetalum*, and to all identifications staff at the various herbaria for the service you provide, even under very trying circumstances. Thanks also to Lucas Grenadier, Luke Foster and Katie Elsley for field assistance, and the financial support from the NSW Department of Planning, Industry and Environment under the SOS program.

Orchid diversity and occurrence in relation to past fire in Canberra Nature Park

MICHAEL MULVANEY[1*], JULIAN SEDDON[1], TONY WOOD, CATH BUSBY, TOBIAS HAYASHI, JOHN BUSBY, JENNY ANDREWS, GREG BAINES, IAN BAIRD, DALE BILLINGS, MARGARET CLARKE, EMMA COOK, PETER COYNE, NIGEL DEARS, IAN FALCONER, SYBIL FREE, CATHERINE GILBERT, JEANETTE JEFFREY, LUKE JOHNSON, MARGARET KITCHIN, EYAL LEBEDINSKY, JOANNE LYNCH, COLIN MACDONALD, JASON MACKENZIE, SHERIDAN MAHER, JENNIFER MALBON, ALISON McINNES, ANNA McGUIRE, NIC MIKHAILOVICH, MATTHEW MULLANEY, RYL PARKER, DAVID POPE, MAYA POTAPOWICZ, PETER QUINN, ROSEMARY PURDIE, PETER RAMSHAW, JOHN ROBERTSON, EDWINA ROBINSON, JANET RUSSELL, JENNI SMITS, NICKI TAWS, DIWANI VELASQUEZ, JENNIE WIDDOWSON, GRAHAM WILSON, NICK WILSON AND DEBBIE WORNER

[1] Environment, Planning and Sustainable Development Directorate, ACT Government.
Remaining authors are citizen scientists.
*Corresponding author: Michael.Mulvaney@act.gov.au

Background

This research was a collaboration between local residents and the Environment Division of the ACT Government. It was initiated by community concerns that fire management within nature reserves in Canberra was impacting orchid diversity and abundance. The project sought to:

- Survey orchid species occurring across a range of time-since-fire and fire frequency classes.
- Analyse the influence of fire history and terrain on orchid species richness and occurrence of individual orchid species.
- Inform on-going fire management planning and operations in Canberra Nature Park reserves, such that fire managers are able to find an appropriate balance between the protection of life, property and the environment.

Methods

Field survey

Between 24 September 2016 and 16 October 2016, 47 volunteers and research staff visited one or more of 114 nominated points in dry forest and woodland throughout Black Mountain, Aranda Bushland, Bruce Ridge, Gossan Hill and O'Connor Ridge nature reserves. These reserves share a Black Mountain Sandstone geology. Nominated points were selected to represent a range of fire history states and terrain positions (Figure 1).

Participants photographed all orchid species within 50m of the point, designated by a star picket. The photographs were loaded into the innovative cloud platform, *Naturemapr* via the *Canberra Nature Map* portal, where identification was confirmed by three orchid moderators, Tony Wood, Cath Busby or Tobias Hayashi. The GPS locations embedded in the properties within the images derived from smartphones or cameras were used to verify location.

Data analysis

Composition of orchid assemblages at each plot was analysed by Canonical Correspondence Analysis using the 'PAST 3' data analysis software package (Hammer, *et al.* 2001) using presence absence data for each species at each plot. 'Environmental' variables were included in the analysis to provide an indication of the fire history and terrain attributes correlated with the species occurrences.

Orchid species richness was analysed using generalised additive modelling (GAM) with a log link and Poisson

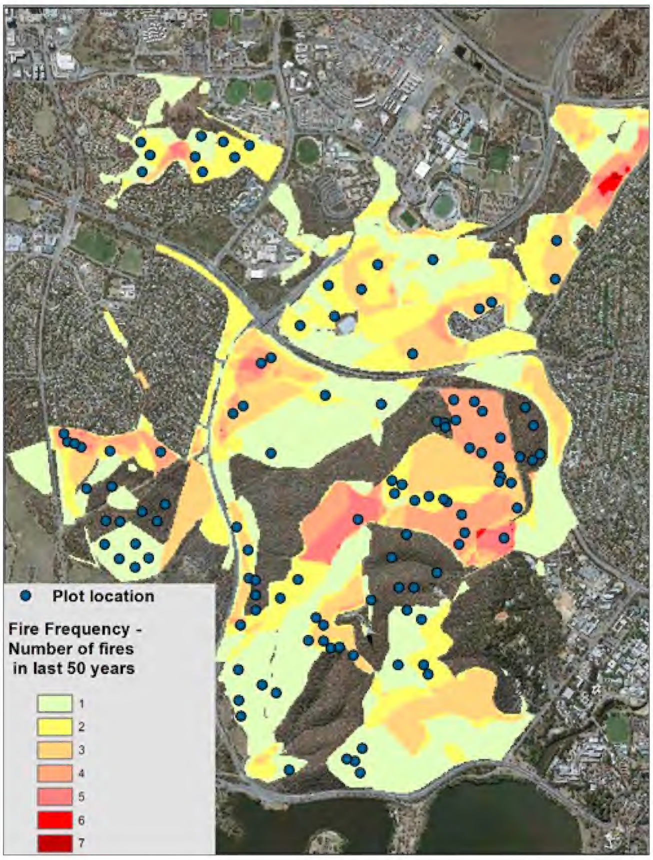

Figure 1: Plot location and fire frequency

error distribution (Hastie and Tibshirani 1990). The following explanatory variables were used: the logarithm (base 10) of the number of years since last burnt (time-since-fire), the number of fires in the previous 50 years (fire frequency), slope, and aspect.

Results

Thirty orchid species were recorded and identified from photographs taken in the plots. On average, just over five different species were recorded per 50m radius plot (0.8ha) with a range from 0 to 15 orchid species. The most widespread species were Dusky Fingers (*Caladenia fuscata*) and Wax Lip Orchid (*Glossodia major).* Twenty orchid species were only found in less than 5% of plots. The plots revealed previously unknown locations of eight orchid species considered rare in the ACT, or nationally.

Orchid species richness in relation to fire and terrain

Orchid species richness was significantly related to the logarithm of time-since-fire (LogTSF), slope and aspect, while fire frequency (FireFREQ) was not significant (Figure 2). Of these explanatory variables, slope was the strongest driver; but only about 19% of the variation in orchid richness was explained by the combination of all these variables. This suggests there may be other drivers of orchid richness that were not measured in this study, or that orchid occurrence has a large ‘stochastic’ element.

Orchid species richness was highest on gentle slopes, declining steadily on steeper slopes, and was highest on southerly aspects (Figure 2). The model predicts a u-shaped relationship between orchid richness and time-since-fire with slightly more orchid species within 3 or 4 years of fire (0.5 on log10 scale) then considerably more species again with longer periods without fire, particularly after about 30 years (1.5 on the log10 scale) (Figure 2).

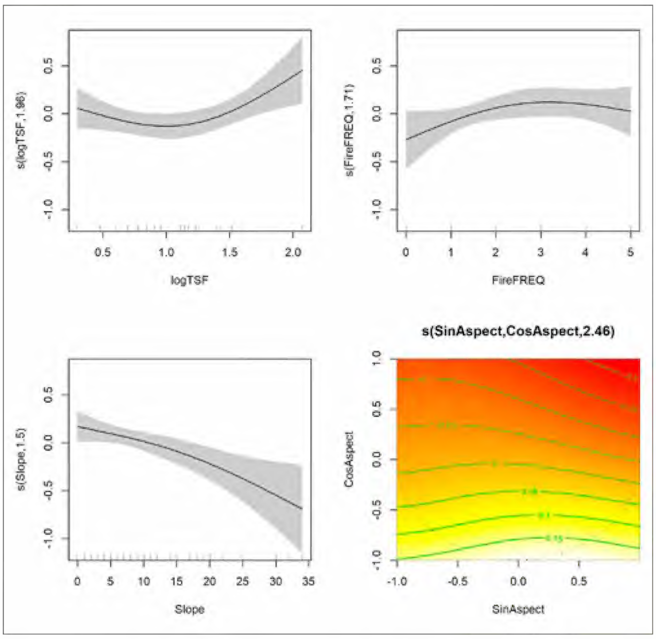

Figure 2. Term plots for partial contribution to generalised additive model of orchid species richness. Logarithm of time-since-fire (LogTSF), slope and aspect (interaction between SinAspect and CoasAspect) were significant terms in the model while fire frequency (FireFREQ) was not significant.

Orchid species fire responses

Widespread and common orchid species on Black Mountain Sandstone appear either not to be influenced by the area’s fire history or to be slightly favoured by more frequent burning. This might be expected given that 79% of the 735 ha Black Mountain Sandstone area has been burnt at least once in the last 50 years, and 47% burnt at least twice in that time.

Nine nationally or regionally rare species were included in the analysis. Of these, Black Mountain Leopard Orchid (*Diuris nigromontana*), Mountain Beard Orchid (*Calochilus montanus*), Thin-clubbed Mantis Orchid (*Caladenia atrovespa*) and Small Duck Orchid (*Caleana minor)* are associated with or found in more frequently burnt areas and are likely to be robust to a continuation of current burning patterns. Black Mountain Leopard Orchid is endemic to the area of study, with an estimated population size of about 1,000. Although this species has a weak association with more frequently burnt areas, it is widespread across Black Mountain and tends to occur on gentle north or north-westerly slopes and is uncommon on steep land.

Brown Beaks (*Lyperanthus suaveolens*) and Broad-sepaled Leafy Greenhoods (*Bunochilus umbrinus*) are associated with long-unburnt areas. Fire should be excluded from known habitats, and if subject to wildfire their responses should be monitored.

Horned Midge Orchid (*Corunastylis cornuta*), Rufous Midge Orchid (*Corunastylis clivicola*) and Common Gnat Orchid (*Cyrtostylis reniformis*) are weakly associated with a moderate fire history and are likely to require habitat that is neither recently or long unburnt.

Fire management

The variation in response of individual orchid species to fire demonstrated in this study suggests that to retain overall orchid diversity of the Black Mountain Sandstone it is imperative that a patchwork of recently burnt and long unburnt areas is maintained across the approximately 735 ha of these reserves. Given that long unburnt areas only constitutes 21% of the total area, continuing to exclude fire from the bulk of this area should be a management priority. Fire planning should continue to build a nuanced and patchwork approach focused on the location and particular fire requirements of the rare orchid species. At a finer scale, where planned burning is required, maintaining the current management goal of achieving patchy low intensity fire coverage within the overall footprint of each burn will help to retain diversity at the local scale

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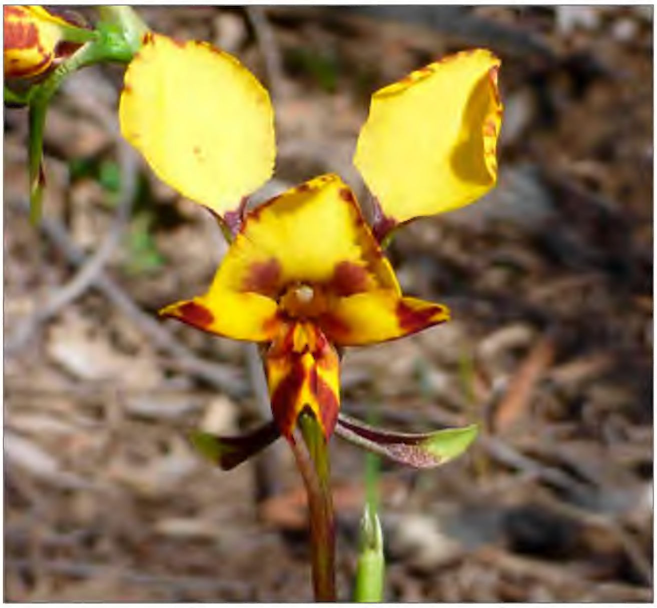


Figure 3. Black Mountain Leopard Orchid – fire tolerant. Photo: Rosemary Purdie

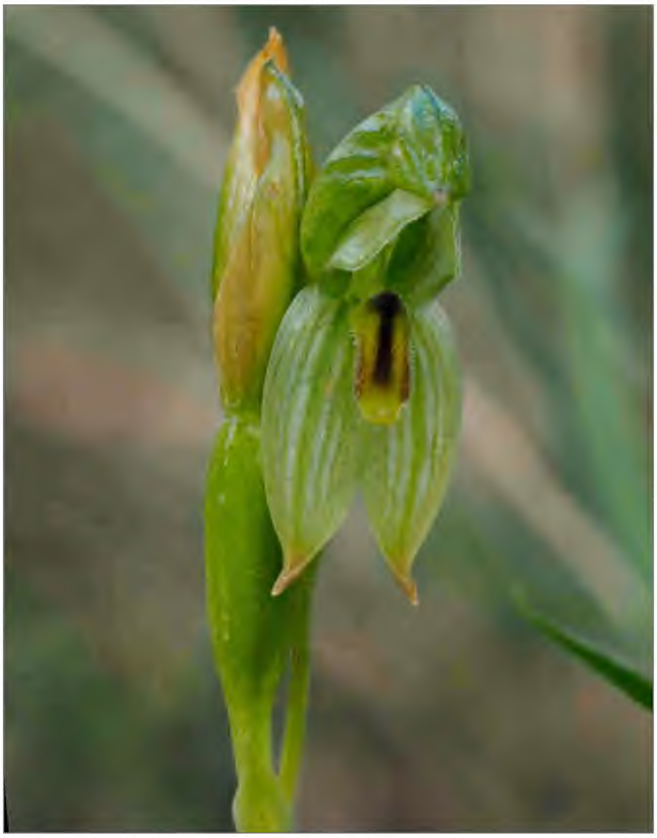


Figure 4. Broad-sepaled Leafy Greenhood – fire sensitive. Photo: Ken Thomas

International Year of Plant Health

BRETT SUMMERELL

Royal Botanic Gardens & Domain Trust, NSW.
Corresponding author: brett.summerell@rbgsyd.nsw.gov.au

In 2020, we will not only be commemorating the visit of Joseph Banks and Daniel Solander to the east coast of Australia with James Cook 250 years ago, but we will also be recognising the importance of plant health to humanity and our environment. The United Nations have designated 2020 as the International Year of Plant Health with the aim of increasing awareness of the importance of healthy plants and the necessity to protect them.

The impact of pests and diseases on plants in natural environments around the world has exploded over the past ten years. In Europe, Ash Dieback, caused by the fungus *Hymenoscyphus fraxineus*, has devastated ash (*Fraxinus excelsior* and other species) forests on the continent and in the United Kingdom. In the United States, *Phytophthora ramorum* causes Sudden Oak Death in Tanoak (*Notholithocarpus densiflorus*) and coast live oak (*Quercus agrifolia*) forests on the west coast, and *Phytophthora agathidicida* is rampaging through Kauri (*Agathis* spp.) forests on the north island of New Zealand. On the pest front, my own experience of travelling through conifer forests stripped bare by the Mountain Pine Beetle for hours in the Rockies in Colorado and California was a very depressing experience; nearly 3.5 million hectares are affected. Of course, in our bushland diseases like Myrtle Rust (*Austropuccinia psidii*) and Phytophthora Root Rot (*Phytophthora cinnamomi* and a number of other *Phytophthora* species) are sending species closer to extinction and there are plenty more pests and pathogens waiting to come into the country, including some of those mentioned above, to cause even more havoc.

Botanic gardens obviously have a very strong interest in maintaining plant health – it is key to being able to produce our displays and in protecting rare and threatened species that are at risk from extinction. Despite the importance of plant health few botanic gardens around the world have an active plant pathology research and diagnostic capability, so the Royal Botanic Garden Sydney plays an important role nationally in raising awareness of the impact of plant diseases in horticulture and in the natural environment.

Botanic Gardens Conservation International, the peak body for botanic gardens, developed the concept several years ago of an International Plant Sentinel Network, where botanic gardens play a role in detecting new arrivals of insect pests and disease causing organisms such as fungi, bacteria and viruses. Indeed, botanic gardens can also play a critical role in raising awareness of the importance of plant health – an example is the interpretation display and the opening up of the PlantClinic facility at the Royal Botanic Garden Sydney.

Our Australian botanic garden community has recently teamed up with Plant Health Australia to start to develop a plant health sentinel network across gardens nationally. Botanic gardens are one of the most visited tourist destinations in Australia with many millions of visitors each year, a great proportion of them from overseas. So it makes sense that one of the most likely places for a new disease or pest incursion to occur would be in a botanic garden – the environment is usually favourable, there are a diverse range of different potentially susceptible host plants and the gardens are often the first place visited when tourists get off a plane (what better way to walk off the jet lag!).

A group of target diseases and pests have been selected for surveillance in the first component of the program and a number of horticultural staff from many of the major botanic gardens have been trained in detection methods, monitoring and reporting. The five pests and diseases that have been selected are Myrtle Rust (because of the concerns of new more aggressive strains being introduced into Australia), Brown-Marmorated Stink Bug (*Halyomorpha halyos*) which attacks a broad range of host plants, Rose Rosette virus, Polyphagous Shot Hole Borer (*Euwallacea* spp. and a number of associated fungi that it vectors) which attacks a number of tree species and Stigmina Leaf Spot (*Stigmina platani*), a pathogen of *Platanus* species. These species were chosen because of their importance across a range of plant species found in botanic gardens, importance to food production and potential impact on the natural environment. The other factor was that they are relatively distinctive and provide a good opportunity for botanic gardens staff to develop capabilities in diagnostics.

The next component of the program that will be facilitated by Plant Health Australia will be extending this knowledge to friends of the gardens groups in the Royal Botanic Garden Sydney, the Australian National Botanic Gardens in Canberra and the Royal Botanic Gardens Victoria. This broadens the network and allows the development of expertise that can be extended to the community.

As we often say Plants = Life and healthy plants are the foundation of a healthier life, more effective ecosystem functions and improved food security. Plant pests and diseases damage crops, reducing the availability of food and increasing its cost. Sustaining plant health protects the environment, forests and biodiversity from plant pests, addresses the effects of climate change, and supports efforts to end hunger, malnutrition and poverty. The International Year of Plant Health will be a great opportunity to once again stress the importance of plants and overcome some of that “plant blindness”.

News from the ASBP partnership

Showing students the science of seeds

Introduction by Damian Wrigley, National Coordinator, Australian Seed Bank Partnership

Seedbanks and the science that underpins our work provide practical and fun options for students to engage with native plant conservation. Seedbanks provide a safe space for students to understand the importance of Australia's native plants and to explore the science and techniques that underpin native seed collection, use and conservation. We would like to say a big thank you to the students from Woodlupine Primary School in Western Australia and Kildare College in South Australia for helping our seed banks to conserve native species and for sharing their perspectives on what they've learned from our seed science experts.

Woodlupine Primary School and the Western Australian Seed Centre

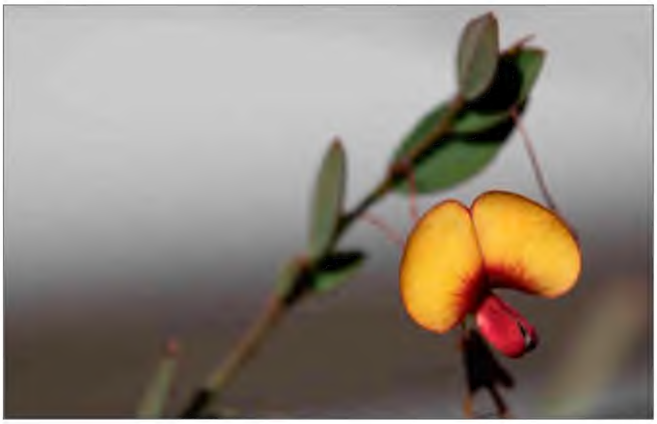
ANDREW CRAWFORD[1*] AND TREVOR PHOEBE[2]

[1] Western Australian Seed Centre, Kensington, Department of Biodiversity, Conservation and Attractions.
[2] Woodlupine Primary School, Western Australia.
*Corresponding author: Andrew.Crawford@dbca.wa.gov.au

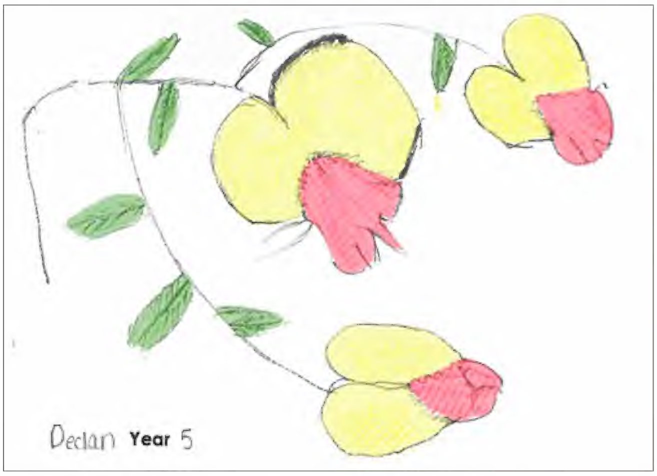
Nestled in the foothills of the Darling Range in Western Australia lies Woodlupine Primary School. Like all primary schools, the basics of a good education, including reading, writing, mathematics and science are covered. However, the school was seeking to instil more than these basics in their students, they were wanting to develop skills, attitudes and knowledge that would help them meet the changing demands of the 21st century. There was a realisation that the planet is facing some significant environmental challenges, and rather than waiting for others to come up with solutions the school was wanting a way of becoming involved in conservation in a practical, but meaningful way.

It was with this thinking that the idea for the seed project was born. School Principal Trevor Phoebe had heard about the work being carried out around Australia by the Australian Seed Bank Partnership, and so approached the partnership for ideas of how to become involved. He then contacted the Western Australian Seed Centre where the idea of establishing a seed production area, to grow and collect seed of conservation significant plant species, was developed. The project was officially launched in May 2019 and seed has already been collected from two of the three species established in the initial trial phase of the project (*Bossiaea modesta* and *Puccinellia vassica*). The third species, *Schoenia filifolia* subsp. *subulifolia* has flowered and seed is in the process of being collected.

On the next page, we have some contributions from the students of Woodlupine Primary School, their thoughts on the project, and what they are learning from it.



Bossiaea modesta. Photo: Andrew Crawford



Drawing of _Bossiaea modesta_. Declan – Year 5, Woodlupine Primary School

The project is important because

The bosia modesta is endangered and if
we dont look after it, it will die out
and then more plants will die.

Alice – Year 5, Woodlupine Primary School

We can help them and if we
dont there might not be anymore
and they might not grow again.

Aoife – Year 5, Woodlupine Primary School

it helps endangered flours
grow by storeing seeds in the
seed bank.

Harvey – Year 6, Woodlupine Primary School

lots of plants are becoming
endangered

Lexi – Year 5, Woodlupine Primary School

we learnt about how to save some
endangered plants and facts about them,
which ~~tells~~ us how to save these plants.
It also helps us engage in social activities.

Jesse – Year 5, Woodlupine Primary School

Everyone needs to help endangered flowers
and try to bring them back and that
is what we are doing in W.P.S.

Makayla – Year 5, Woodlupine Primary School

If we dont protect them or help
them, its likely it will go exstinct.

Skye – Year 5, Woodlupine Primary School

That different plants have different
~~requierx~~ requiermnents like some plants
have to have particular soils, temperatures, ect

Alice – Year 5, Woodlupine Primary School

From doing this project i have learnt

I have learned that theres alot
of endangered plants and
that we can do alot to help them

Aoife – Year 5, Woodlupine Primary School

that flowers and trees are very important
to us and if we don't save the nature
we will be in danger

Febe – Year 6, Woodlupine Primary School

Tosave
plantsanddontd isrospect them

Hunter – Year 4, Woodlupine Primary School

facts about the bossiaea
modesta and how alot of plants/flowers are
endangered, I also learnt how we can
save these plants. I learnt that the bossiaea
modesta grows in the south west of WA.

Jesse – Year 6, Woodlupine Primary School

I think

More schools and homes should be
looking after this plant.

Alice – Year 5, Woodlupine Primary School

Other school should start doing it because it is very
educated, exiting,' and you can save the world!

Febe – Year 5, Woodlupine Primary School

Weshouldsaveindangered
plantssotheydontgetinstinked.

Hunter – Year 5, Woodlupine Primary School

This project is good our school is
helping native plants to bring them back.
because if we don't start making changes
who will so that is why me and the rest of
the kids did this project.

Makayla – Year 5, Woodlupine Primary School

Seeds and Students of South Australia

JENNY GUERIN AND DAN DUVAL*
South Australian Seed Conservation Centre, Botanic Gardens and State Herbarium of South Australia.
*Corresponding author: Daniel.Duval@sa.gov.au

Through its South Australian Seed Conservation Centre, the Botanic Gardens of South Australia is currently the sole organisation in South Australia collecting and banking native threatened plant species in long term storage for future recovery programs and undertaking seed germination research. In the past fifteen years it has achieved collections for more than 80% of South Australia's threatened flora. Numerous threatened species are decreasing in their overall distribution with many populations now in serious decline. These smaller populations represent an important part of the genetic diversity of the species and are at risk of extinction in the short term. Approximately 50% of South Australian orchids are threatened and the majority of these have never been propagated. Staff at the Seed Centre are conducting research into the symbiotic germination of orchid seeds using specific mycorrhiza isolated from orchid tissues. The threatened orchid program is in partnership with Dr Noushka Reiter (Royal Botanic Gardens Victoria) who has propagated some threatened orchids for this project, and has provided invaluable technical advice about orchid propagation and translocation.

Students on a science extension program from Kildare College regularly visit the Seed Centre throughout the school term for laboratory practical sessions assisting with different stages of orchid propagation. Some students have been involved with the program for three years and mentor new students to the program. These include hand pollination and seed collection in the field, isolation of mycorrhizal fungi from root, stem and collar tissues, and germination of seeds-all under aseptic conditions in the laboratory. Young seedlings are then grown in sterile flasks until they can be transferred to potting soil in the nursery. Four species of threatened orchids have been translocated back into suitable habitat this year. The largest known population of the White Beauty orchid (*Caladenia argocalla*) (listed as Endangered under the *EPBC Act*) in the Mt Lofty Ranges had 25 flowering plants with 21 pods in 2019. The threatened orchid program translocated more than 50 plants to this location in 2019. This translocated population produced 27 flowers and 24 pods. An important part of the program has been to provide students with hands on technical experience and to provide opportunities to follow through on this work to demonstrate the tangible conservation outcomes achieved in the field.

Student hand pollinating *Caladenia reticulata* at Blackhill. Photo: Laura Kretschmer

The students from Kildare were asked to provide their feedback on the orchid program and a summary is provided below.

Why do you think the partnership between Kildare College and the Seed Conservation Centre is important?

- Experience a whole new field of study.
- Work closely with real life scientists.
- Able to experiment using authentic scientific equipment.
- Learned about the reasons behind plants/orchids becoming endangered.
- More of an understanding about conservation.
- Skills to address some of the problems.
- Important for kinaesthetic learners who enjoy to learn from hands on work.
- Assisted with deciding about future occupations.
- Put into perspective the role of humanity in saving endangered species.
- We get to be part of something that otherwise we just hear about.
- We get to have a role in conservation.

What have you learned most from the workshops and working closely with Dan and Jenny?

- How to use specialised lab equipment.
- Unique insight into this field of work.
- The importance of patience.
- Appreciate the small wins and learn from the losses.
- I feel as though I am part of something that is making a change in Australia and supporting endangered species.

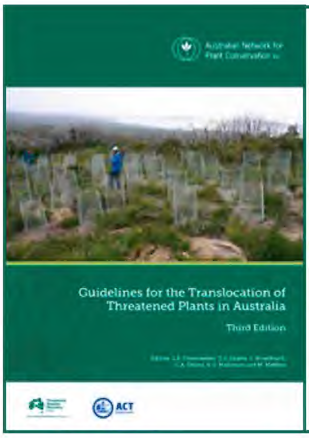
Caladenia argocalla X76 and X77 flowers. Photo: David Kilpin

What have you enjoyed most?

- The opportunity of a lifetime.
- The ecology of orchids.
- Working in an authentic lab with real life scientists using specialised equipment.
- Learning in a professional environment outside of school.
- The field trips to hand pollinate *Caladenia tentaculata*.
- There is something about seeing these orchid species in the wild and connecting all the work we've done in the labs to what we are seeing in person in nature that is kind of legendary.

Any feedback?

- Do more of this.
- More time allocated to lab and theory work at school.


Guidelines for the Translocation of Threatened Plants in Australia
Third Edition

Guidelines for the Translocation of Threatened Plants in Australia

The ANPC's brand new third edition is on sale now! Step-by-step information on how to do best-practice translocations, improve translocation success and contribute to preventing plant extinctions.

Third Edition 2018 | Eds L.E. Commander, D.J. Coates, L. Broadhurst, C.A. Offord, R.O. Makinson and M. Matthes. Australian Network for Plant Conservation, Canberra.

For more information and to order, go to http://www.anpc.asn.au/translocation

ANPC workshop reports: special feature

An overview of the ANPC Australian native seed industry survey

PAUL GIBSON-ROY[1*], NOLA HANCOCK[2], MARTIN DRIVER[3] AND LINDA BROADHURST[4]

[1] Kalbar Resources, PO Box 7641, Cloisters Square, Perth WA 6850.
[2] Macquarie University, North Ryde, NSW 2109.
[3] Australian Network for Plant Conservation, GPO Box 1777, Canberra ACT 2601.
[4] CSIRO NRCA/Australian National Herbarium, GPO Box 1700, Canberra ACT 2601.
*Corresponding author: paul.gibsonroy@kalbarresources.com.au

Background

The Australian native seed sector is a critical component of the ecological restoration industry and comprises a wide range of individuals, businesses and organisations. The seed sector faces serious challenges as a result of many interacting factors, including the continued loss and fragmentation of native vegetation, low levels of restoration funding, and the impacts of climate change. To help prepare for such challenges, the ANPC with support from the Rural Industries Research and Development Corporation (RIRDC), conducted a national survey which aimed to better understand current sector structures and practices, to gauge the sector's capacity to meet current and future demand for native seed, and to gather feedback on issues that are perceived by the sector to be affecting their activities.

Grass harvester with a load of seed. Photo: Paul Gibson-Roy

Survey method

Participants were invited to contribute to the survey using the online survey tool SurveyMonkey® (https://www.surveymonkey.com/). Invitations were directed to those on the ANPC database and more widely to seed industry professionals and those from plant conservation and restoration. A total of 146 survey responses from across Australia were received between Oct 2016 and April 2017. After answering a question to identify their primary sector role respondents were categorised into one of four groups (Seed Collectors, Seed Production Area (SPA) Growers, Seed Purchasers and Other Users) and then answered between 18 and 25 multiple choice questions (depending on their group). Questions allowed for written comments, which were reviewed and, where possible, incorporated into the final report.

Key findings and issues

Thirteen pressing issues facing the sector were ranked by respondents in order of importance. This order varied depending on the respondent's primary role in the sector, but when combined across the four groups, the issues ranked of most importance were:

- Future demand for seed will be difficult to meet from wild harvest.
- Markets are unwilling to pay the true cost of seed collection/production.
- There is a lack of seed available from a broad range of species for restoration.
- Demand for seed is inconsistent and/or unpredictable.

A range of questions focused on quantitative and qualitative information on sector structure, behaviour and practice. Key findings from these were:

- More seed is collected from private property than from other land tenures (with collection being lowest in national parks).
- A large proportion of the seed harvested by suppliers comes from geographic ranges that greatly exceed those considered to be 'local provenance'.
- Seed Purchasers commonly accept seed from locations much farther away from the planting site than is commonly thought.
- Current provenance range stipulations are considered too restrictive.
- Native seed is not commonly tested to determine its quality attributes.
- Most seed collections or seed purchases (over an annual period) are small in volume (i.e. usually <5 kg) suggesting that overall native seed volumes are

modest in quantity and not sufficient to support large-scale restoration.

- Seed production areas are an increasingly important supplier of native seed.
- The formation of a peak industry group to represent the native seed sector is highly desirable.

Major constraints and challenges

Survey findings raised serious concerns about the ability of the sector, as currently constituted and resourced, to meet projected future increases in the demand for seed or for achieving greater effectiveness and efficiency in ecological restoration outcomes. Some of the factors that underlie these concerns are:

- **Climate change impacts**. Although climate change was not a prime focus of the survey, signs that a rapidly changing climate are disrupting practices within the sector were noted in survey comments.
- **Declining wild seed**. As native vegetation continues to decline across many landscapes, the sources for native seed were reported to be also declining or under strain.
- **Demand is inconsistent and unpredictable**. The survey found the market for seed is subject to strong fluctuations in demand, often imposed by vagaries of governmental program funding (in which the sustainability of infrastructure for conservation and NRM is rarely considered), and a paucity of markets.
- **Seed pricing.** There is a complex chain of activities for providing native seed (i.e. sourcing, harvesting, processing, cleaning, testing, storage, packaging and shipping) and many seed suppliers feel that they are not properly compensated for their expertise or for the many inputs required to source/produce seed.
- **Small work force.** The native seed sector is underpinned by a remarkably small work force that primarily consists of sole- or small-operators. This presents a clear risk to all users of native seed, not only in terms of current capacity, but also if there are large and rapid increases in demand in the future.

A paddock of Kangaroo grass (i.e. seed source). Photo: Paul Gibson Roy

Call to action

The final survey report presents a number of actions intended to improve sector efficiencies and outcomes. Some areas of targeted actions are outlined below.

1. **Improved market incentives**

   While development approval offset programs (i.e. mining or urban development) are growing areas for seed and restoration, new and targeted market incentives are required to help drive sustained growth for seed and restoration markets. Ideally, federal and state government incentives would promote diverse native ecosystem restoration for its own sake, or as a co-benefit for developing more sustainable farming systems, better managed transport corridors, meeting carbon emission reductions, soil and water security, and generating employment and community wellbeing.

2. **Strategic expansion of seed production areas (SPAs)**

   Survey respondents recognised the need for the strategic development of more well-managed SPAs to help deliver large quantities of high-quality seed from a diverse range of species for restoration, particularly for herbaceous and shrub species.

3. **Regional coordination**

   Greater coordination in the planning and inception stages of restoration programs at regional scales, with appropriate input from the native seed sector, would greatly increase the predictability of demand. Regional or multi-regional reviews that consider broader scale restoration goals alongside current and predicted capacity to formulate realistic seed strategies would assist in planning for and delivery of restoration projects and would create greater certainty and transparency for those regional sectors.

4. **Review programs and policies**

   Reviews of environmental and development planning processes, and of funding programs that support restoration in the NRM and conservation contexts are desirable to (a) establish better modelling of costs of seed supply and purchase; (b) consider the values (ecological, cultural and economic) that can be added to restoration projects by greater use of native seed; and, (c) consider the benefits of alignment of projects and funding programs to encourage and stabilise the market for quality native seed.

5. **Industry voice**

   There was overwhelming support from respondents for the development of an industry body to represent and advocate for the native seed sector. The role of such a entity would be to help unify the sector across and within jurisdictions and to provide a clear focus on elements critical to developing its capacity and capability, including developing guidelines and standards, supporting government policy development, exploring and building new markets, identifying research gaps, and providing support and training opportunities.

Concluding comments

There is no single coordinating entity or agency responsible for regulating or collating data on the Australian native seed sector and so it is difficult to determine if those who participated in the ANPC native seed survey are a representative sample of the whole sector. Despite this caveat, participant responses are likely to provide quantifiable baseline sector data that reveal important trends and shed light on a range of beliefs and behaviours that until now have largely been anecdotal. Participants within this sector are highly committed to facilitating better environmental outcomes, but it is clear from the survey they believe this should be achieved in a more effective manner. Stable, productive and rewarding careers are also sought. It is hoped that the results and recommendations from this survey will assist governments and the sector to develop and implement more effective and efficient environmental policies that better support people and markets focused on restoring Australia's biodiversity and other areas where native seed is fundamental. The full survey report will be released in early 2020.

Healthy Seeds Project: Current Barriers – Future opportunities

MARTIN DRIVER

ANPC Project Manager

Healthy Seeds
PROJECT
Australian Network for Plant Conservation Inc
The Royal Botanic Gardens & Domain Trust
NSW GOVERNMENT
AUSTRALIAN SEEDBANK PARTNERSHIP
SER AUSTRALASIA SOCIETY FOR ECOLOGICAL RESTORATION
Greening Australia
CENTRE FOR AUSTRALIAN NATIONAL BIODIVERSITY RESEARCH
AABR

The NSW Healthy Seeds Project has been funded from the NSW Environmental Trust to enable the ANPC and Consortium partners to examine issues that constrain or devalue investment in native vegetation restoration projects in NSW. The outline of the National Native Seed Industry Survey presented by Paul Gibson-Roy has identified a number of these key issues that impact on supply or quality of native seed supply and which will form the basis of the investigations in NSW.

The project assumes that NSW is intending to maintain and extend the support of vegetation restoration across NSW and that the supply of reliable and quality seed is integral to this. The project aims to look at all aspects of the native seed supply chain from seed sourcing, seed collection, seed processing, seed storage and data management to seed supply and sale and seed use in restoration.

ANPC is a lead partner in the Healthy Seeds Consortium consisting of CSIRO, NSW Department of Planning, Industry and Environment (including the Saving our Species program), Royal Botanic Garden Sydney, Australian Seed Bank Partnership, Greening Australia, Australian Association of Bush Regenerators and the Society for Ecological Restoration Australasia.

The Healthy Seeds Project will enable the resourcing of a number of interlinked products and outcomes. It will fund the publication of the **National Native Seed Industry Survey** in both summary and extended forms through ANPC and its partners. It will also enable an update of the **Florabank Guidelines** which are the key seed collection standards, training tool and benchmark requirement for seed collection licensing in NSW. A key element of investigation will be the **Investigation Audit** of native seed supplies and seed use in NSW Local Land Services and NRM regions looking at funding, supply/demand quantities, species availability, staffing/ employment and training needs, co-ordination, collection sources, site access and licensing, permit systems and the role of Seed Production Areas (SPAs). This process will also enable elicitation of the key local, regional and **State Barriers and Opportunities** to native seed supply quantity and quality. From this data and feedback, a **Draft Roadmap** will be produced at the end of the 18 month Stage 1 of the project that will outline some key likely effective and efficient interventions that could be tested in various critical stages of the seed supply chain and priority geographic areas of the State.

The intent of the entire project is to bring together a number of disparate elements of a fragmented native seed supply system to ensure that best practice is identified, specified and documented at all levels of delivery. It is also intended to try to identify and address those critical components where market failure is impacting on either quality, outcomes or sustainability in the most effective way.

Contact: Martin Driver projects@anpc.asn.au
Mobile 0400170957

See https://www.anpc.asn.au/healthy-seeds/ for more information on this project.

Communique from the NSW restoration industry AABR /ANPC - 'Seeds for the Future' Forum – Oct 8, 2019, Sydney, Teacher's Federation Auditorium

The ecological restoration industry is small but critical to the future of biodiverse native ecosystems in Australia, ecosystems that are essential to our nation's clean water, functional soils and carbon capture and storage. Great strides have been made in developing successful methodologies for restoring complex ecosystems using a combination of assisted regeneration and reconstruction techniques. Barriers exist, however, to the necessary expansion of the industry if it is to make a difference to biodiversity conservation. One critical barrier is the time lag required to collect and supply the seed required for restoration which is almost always longer than the short lead times for funding contracts. A second barrier is the wildly fluctuating demand for seed due to either dry years or the chance occurrence of large developments which impacts on the viability of many organisations or operators.

There is a need for more sustained drivers for the seed and restoration industry. Market demand needs to reach a larger scale to make it economically viable for suppliers to risk investment in seed collection and storage or cultivated seed production. Investment in seed production is required to reduce pressure from harvest from self-sustaining natural systems, increasing harvest volumes and efficiencies and managing genetic diversity of supply. The primary current driver for restoration is for work required as a result of development consents (e.g., mining and urban development). More ambitious incentives for diverse ecosystem restoration for its own sake are required, as well as the necessary planning to ensure investment in appropriate physical and organisational infrastructure.

The Forum calls upon State and Federal governments to direct incentive funding to biodiversity restoration and the infrastructure required to support it, whether solely for conservation, as a co-benefit for developing more sustainable farming systems, better managed transport corridors, meeting carbon emission reductions, soil and water security or generating employment and community wellbeing.

With the increase in demand for restoration will come drivers for improvements to restoration training, native seed collection permitting and regulation, increased development of seed production farms and the establishment of standards for high quality seed supply. As beaurocratic barriers to these improvements exist, the Forum calls upon agencies at all levels of government across Australia to work with industry and non-profit restoration organisations to streamline solutions in these areas.

ANPC Member profile

Peter Marquand – Curator Parks and Nursery, City of Ballarat

My area of responsibility includes the Ballarat Botanical Gardens, Buninyong Botanic Gardens, Victoria Park and Eureka Stockade Gardens. Victoria Park includes a large area of remnant grasslands located in suburban Ballarat. Within the Ballarat Botanical Gardens is the North Gardens wetlands which processes urban storm water runoff before it ultimately enters Lake Wendouree. The Ballarat Botanical Gardens began in 1857 and is largely planted with non-indigenous plants.

My team are currently working on several conservation projects in conjunction with the Department of Environment, Land, Water and Planning (DELWP), Royal Botanic Gardens Victoria (Melbourne), Ballarat Field Naturalists and the City of Ballarat's lakes and waterways crew. The following is a list of plants we are currently working with:

- *Lepidium hyssopifolium* (Basalt Peppercress).
- *Bossiaea vombata* (Wombat Bossiaea).
- *Senecio behrianus* (Stiff Groundsel).
- *Coronidium gunnianum* (Pale Swamp Daisy).

The gardens team have collected both seed and cutting material with the aim of establishing *ex situ* plantings within the Botanical Gardens and North Gardens wetlands.

We have also been accepted to take part in the Care for the Rare program. Care for the Rare is an initiative of Royal Botanic Gardens Victoria and Botanical Gardens Australia and New Zealand (BGANZ) to establish multi-site conservation collections across several Victorian regional botanic gardens. Further information on the program can be found by accessing the following video link https://vimeo.com/334527904.

How did we end up working in plant conservation? We had previously thought we were too small a garden and without the necessary resources. What we discovered early on was that we could collaborate with other groups and together make it happen.

On site inspection for the Care for the Rare program L-R Peter Marquand Curator Parks and Nursery City of Ballarat, Chris Russell Executive Director of the Cranbourne Gardens Royal Botanic Gardens Victoria, John Arnott Manager of Horticulture of the Cranbourne Gardens Royal Botanic Gardens Victoria and Councillor Jim Rinaldi City of Ballarat. Photo: Marcus Power

One of the recent highlights was the discovery of *Dianella amoena* (Matted Flax-lily) within the grasslands of Victoria Park. This discovery indicated how important the remnant grasslands are and sometimes rare and endangered plants can be under our nose.

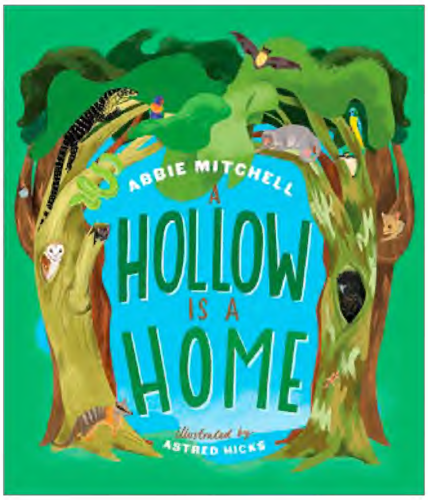
For my favourite plant I am selecting the *Araucaria bidwillii* (Bunya Pine). In the Ballarat Botanical Gardens, we have seven Bunyas, some of which would have been planted in the late 1800s. The trees offer a distinct contrast to the largely non-Australian plants in our collection thanks to their sheer size; and this structure of these trees is amazing.

I think the ANPC network is important as a means of communicating with others working in the area and encouraging others to have a go. One of the biggest issues that we are facing is the loss of natural species and grasslands through urban expansion.

Book reviews

A Hollow is a Home

Abbie Mitchell, illustrated Astred Hicks, 2019. CSIRO Publishing, Clayton South. 104 pp. ISBN: 9781486308057. RRP $29.99

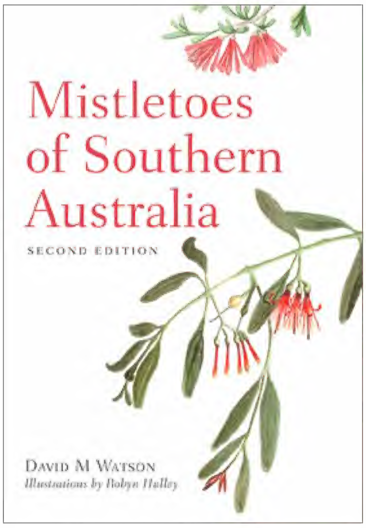


Abbie Mitchell has written a fantastic publication which allows the reader to delve into the fascinating world of tree hollows and the wealth of biodiversity that they support. Her book contains a great balance between informative and easy to understand text, beautiful illustrations (courtesy of the talented Astred Hicks) and well selected photographs. Topics covered include the formation of hollows, various uses and selection thereof, hollow maintenance, threats to hollows, alternative homes, and finding and creating hollows of your own. The book crosses over the age divide, with both young and old being able to enjoy the content. Our young boys, Sam (10) and Nate (8), were thoroughly engaged as they navigated each section of the book. The regular creature features were a highlight for both of them, facilitating further insights into Australian fauna and their intricate dependence on tree hollows. As biologists, my wife and I enjoyed the thorough approach adopted by Mitchell in covering all aspects of hollows and their residents. We also appreciated the scientist profiles which created a link to real world research and the importance of citizen science in understanding animal ecology. This book would make an excellent addition to any budding naturalist's bookshelf.

Reviewers: Andrew, Sue, Sam & Nate McConnachie, biologists & those in training, Orange, NSW

Mistletoes of Southern Australia

David Watson, 2019. 2nd edition. CSIRO Publishing. 224 pp. ISBN: 9781486310944. RRP $59.99



Following a life-long passion for mistletoes, Dr Watson has produced a comprehensive and captivating book that dives deep into the history, life-cycle and wider ecological relevance of *Mistletoes in Southern Australia*. This second edition expands the first edition from 2011 by featuring a new species, as well as revised distribution maps and cleverly crafted hand-painted illustrations by Robyn Hulley, which are further complemented with stunning landscape and macro-photography. Watson starts with an introduction about the biology and life cycle of parasitic mistletoe plants, which entirely rely on water and nutrient provision from a host plant. This is followed by a brief introduction into species identification, supplying the non-expert with the necessary tricks required for identifying individual mistletoe species in the field.

The comprehensive species accounts section constitutes a significant portion of the book. It comprises 47 alphabetically organised species of mistletoe from the families of the *Loranthaceae* and *Viscaceae*, allowing identification of all mistletoes occurring in Victoria, NSW, SA and the southern half of WA. The colour-coded margin easily directs the reader to the species account section, and a succinct bold sentence summarises the distinguishing characteristics of each species. A particularly unique feature of this book are the beautiful, detailed and information-loaded water colour paintings from Robyn Hulley, which provide a clever visual summary of the life cycle of flowers and foliage of each species. These hand-painted illustrations are complemented with astonishing landscape and macro photographs, bridging the abstract and the real world. Species-specific distribution maps give a visual overview of the plant's distribution range in Australia, which along with a succinct verbal description of habitat and host associations provide enough clues for the curious reader to distinctively identify a local individual.

With an updated and comprehensive section on mistletoe ecology, Watson provides a timely summary of mistletoe-host interactions and dynamics, pollination and seed dispersal, as well as the importance of mistletoes as a source for food, shelter and biodiversity. Watson further delved into historical records to excite the reader with the cultural significance of mistletoes and tells a vivid story of mistletoe perception throughout time. The book concludes with a chapter dedicated to the application of past and current management practices and restoration efforts, providing a well-balanced view of mistletoes as friends and foes.

This fascinating, well-written and colourful book presents a comprehensive account of the mistletoes of southern Australia and their wider ecological function, which will satisfy the interest of the botanist, ecologist, and layman alike. Watson's admiration for mistletoes shines through each individual section, and his engaging narrative will certainly infect the reader with his curiosity about the identity and wider ecological relevance of the mistletoe plant spotted in the urban back yard, on a hike through the bush, or on a drive through the Australian countryside.

Reviewed by Anne Griebel

News

ANPC News

ANPC Threatened Plant Translocation Workshops

The ANPC is available to run workshops to showcase the new information in the latest Plant Translocation Guidelines. Based on the recently published 3rd edition of the ANPC's 'Guidelines for the Translocation of Threatened Plants in Australia', translocation workshops provide a step by step guide on how to translocate plants. ANPC Project Manager Dr Lucy Commander, lead editor of the 3rd edition, is available to coordinate and lead Translocation Workshops anywhere in Australia. Three successful workshops have already been held in Canberra (Nov 2018), Perth (March 2019) and Adelaide (May 2019). The ANPC would welcome the opportunity to present a plant translocation workshop in your region. Registration fees depend on the amount of funding available (either from an institution or a successful grant application) to cover such expenses as catering, venue hire and ANPC staff time and travel. Please contact the ANPC's Business Manager, Jo Lynch, at business@anpc.asn.au for further information and request a quote, or to collaborate on a grant application. **https://www.anpc.asn.au/threatened-plant-translocation-workshops/**

Presenters and participants at the South Australian plant translocation workshop in May 2019. Photo: Kylie Moritz

New Global Host List for Myrtle Rust pathogen

ANPC is proud that our website is the publication point for an updated Global Host List for the plant pathogen *Austropuccinia psidii*, the causative agent of Myrtle Rust disease, by Julia Soewarto and co-authors. The new Global Host List shows that the host range now stands at 480 nominate species (524 taxa when subspecies are counted separately, as they are in Australian conservation practice). This host range, and the rapid geographic spread of one strain of the pathogen, demonstrate that Myrtle Rust disease is now a major threatening process for the Myrtaceae family on a global scale. Download the new global host list here **https://www.anpc.asn.au/myrtle-rust/**

For Australian users, be aware that some of the scientific names and ranks (species vs subspecies) on this list differ from current usage in Australia or in some States, as it is based on a master-list of taxa from RBG Kew in the UK (and similar discrepancies may apply to some New Zealand host species). A few undescribed but phrase-named species, fully accepted in Australia, are also omitted for the same reason (e.g. *Lenwebbia sp*. 'Main Range' and *Lenwebbia sp.* 'Blackall Range'). This global list in current form also lacks within-Australia distributional information and some Australian conservation-status information. These details, for all except very recent Australian additions to the global list, can be found in Appendix 3 of 'Myrtle Rust reviewed: the impacts of the invasive pathogen *Austropuccinia psidii* on the Australian environment', current to May 2018, which is downloadable from the same web address **https://www.anpc.asn.au/myrtle-rust/**

Myrtle rust impacting on *Rhodamnia maideniana* at Tallebudgera Valley, QLD, August 2018. Photo: ©Geoff Pegg Agriscience Queensland, DAF

ANPC submission on the Priority list of exotic environmental pests and diseases

The Priority List recently issued by The Commonwealth Department of Agriculture is a significant step in the slow process of building greater awareness and capacity for Australia's environmental biosecurity. The public comment period for the list has now closed, but the list remains available pending its finalisation. The ANPC's submission on the exposure draft (30 September 2019) is available here https://www.anpc.asn.au/submissions/. The ANPC is looking to bring members concerned about environmental biosecurity issues into closer contact with each other, to give us greater capacity on this side of our work. If you are interested in networking on this, please email the office at anpc@anpc.asn.au with subject line 'Enviro biosecurity'. **http://www.agriculture.gov.au/biosecurity/environmental/priority-list**

Spiked pepper (*Piper aduncum*) - a potential weed in the tropical regions of Australia. Photo: Brisbane City Council website

Saving the threatened Audas Spider-orchid (*Caladenia audasii*) from extinction

The ANPC is working with Royal Botanic Gardens Victoria Friends of Grampians Gariwerd – FOGGS and Australasian Native Orchid Society – Victorian Group to save the threatened *Caladenia audasii* from extinction, thanks to funding from the Department of Environment, Land, Water and Planning. *Caladenia audasii* has fewer than 8 plants left in the wild. So far, an exclusion fence has been constructed at one site to protect newly discovered

plants from grazing, seed has been collected and sown for propagation, and plant surveys and pollinator baiting have been undertaken. In spring 2019 more pollinator baiting and surveys for any new plants were undertaken, before re-introducing 50 seedlings in winter 2020.
https://www.anpc.asn.au/audas_spider-orchid/

Caladenia audasii **seedlings ready for introduction in June 2020. Photo: Noushka Reiter**

Australasian Seed Science Conference (ASSC 2020) – Canberra, 5-9 April 2020

Early-bird registrations for this year's Australasian Seed Science Conference have been extended to 8 March. Delegates will discuss the latest advances in seed biology and ecology, seed sourcing and end-use, seed and genebank management and seeds in culture and society. Sponsorship opportunities are also now available. Check out the conference website to see the full 5-day program and register now.
https://seedscience2020.com.au/

AUSTRALASIAN
Seed Science
Conference

Cuttings: Plant news from around Australia

Editors' note: Cuttings news excerpts are clipped from a diversity of sources. To read the articles in full follow the links attached to each clipping. The views expressed in these articles are those of their authors and do not necessarily represent the opinion of the ANPC.

Restoring box gum grassy woodlands

It was once possible to walk from Melbourne to Sydney through almost continuous grassy woodland. Today most of these temperate woodlands have gone.
A team at The Australian National University have been studying woodland restoration and management for the past 20 years and have embarked on a series of new experiments to investigate bird breeding success, noisy miner control, hollow supplementation and wildflower translocation. Drs David Lindenmayer and Daniel Florance provide an update on their latest research findings and activities.
http://www.nespthreatenedspecies.edu.au/news/restoring-box-gum-grassy-woodlands

Seed bank saving species in Western Australia

Threatened plant scientist Leonie Monks is on the front line of saving species in Western Australia. Get a glimpse of what happens behind the scenes at the Western Australian Seed Centre and research to support the reintroduction of threatened plant species back into the wild.
https://www.facebook.com/nespthreatenedspecies/videos/440139453208791/UzpfSTQ4NzE5NzAyNDY0MzQ5MToyNzc0MzgzNzcyNTkxNDYw/

Woodlands across entire east coast to be declared endangered

The federal government is hoping to declare sections of forests across Australia's entire east coast as endangered. The declaration could affect landowners around Batemans Bay, with the environment department suggesting fencing off and protecting remnant patches of the forests on agricultural land. The environment department has invited public comment on its ambitious plan to declare coastal floodplain eucalpyt forests from Rockhampton in northern Queensland, to Sale, in south-eastern Victoria, as endangered.
https://www.canberratimes.com.au/story/6285763/woodlands-across-entire-east-coast-to-be-declared-endangered/?fbclid=IwAR27xFMwkNcpNEK0qHJS4S3FCarb-jyX10mbosYDzRrvAOw5gMncuy3KX-g

Queen of Sheba orchids destroyed by mistake at Gull Rock National Park in WA

A West Australian Government department says it will work more closely with local conservation groups after admitting staff accidentally destroyed a collection of highly coveted native orchids in a national park. Last week a botanical group described scenes of devastation in an area of the Gull Rock National Park, 470 kilometres south of Perth, which volunteers said was once home to approximately 30 of the 200 Southern Queen of Sheba orchids they had surveyed in the region. The southern variant native to Western Australia's south west, is one of three Queen species prized by orchid lovers' and photographers for its flamboyant multi-coloured flowers.
https://www.abc.net.au/news/2019-08-09/government-department-accidentally-destroys-orchids/11396460

Koala habitat cleared for housing development against Environment Department's offset policy

The Federal Environment Department approved the clearing of more than 75 hectares of critical koala habitat west of Brisbane in breach of its own policy. Documents obtained under Freedom of Information laws by the Australian Conservation Foundation (ACF) reveal two housing developments in the Ipswich area "lacked consistency" with the Environment Department's own policy on environmental offsets. Nonetheless, the department approved the land clearing in January 2018 "in order to maintain consistency in decision making" with other projects that had already been given the green light.
https://www.abc.net.au/news/2019-08-13/koala-habitat-cleared-against-department-of-environment-rules/11392454

Improving gamba grass control on Cape York

Improving gamba grass control on Cape York and throughout northern Australia was the topic of discussion at a two-day workshop held in Cairns recently. Over 40 land managers, scientists and weed control experts from across Cape York and northern Australia attended the workshop to contribute their knowledge to the design of herbicide trials which will take place over the next 18 months. Gamba grass was planted across northern Australia as a pasture species in the mid-1980s and has spread rapidly. It was declared a Weed of National Significance in 2012, and listed as a key threatening process under the Environmental Protection and Biodiversity Conservation (EPBC) Act. However it continues to spread, increasing fire risks and significantly disrupting biodiversity and ecosystem services.
https://www.nespnorthern.edu.au/2019/08/14/improving-gamba-grass-control-on-cape-york/

Carnivorous plants and moonscapes: Young Perth ecologist wins prestigious scientist award

A young Perth ecologist and carnivorous plant expert working to restore billions of years' worth of evolution in WA's desolate mine-scapes was awarded early career scientist of the year with a $10,000 prize at the prestigious Premier's science awards on Tuesday night. Dr Adam Cross is a supervisor at Curtin University's ARC Centre for Mining Restoration, a university lecturer and researcher, and the world authority on the carnivorous plant species *Aldrovanda vesiculosa* and *Cephalotus follicularis*. A keen botanist and ecologist since the age of six, Dr Cross now steps into the picture when WA mines near the end of their lifespans. He is often left with the mammoth task of rehabilitating completely destroyed moonscapes in a matter of five to ten years – a process which would normally take nature millions of years – in a bid to meet regulation requirements and restore WA's natural landscapes.
https://www.smh.com.au/national/western-australia/carnivorous-plants-and-moonscapes-young-perth-ecologist-wins-prestigious-young-scientist-award-20190813-p52grt.html

The exquisite blotched butterfly orchid is an airy jewel of the Australian landscape

The blotched butterfly orchid (*Sarcochilus weinthalii*) looks fairly unremarkable when it's not flowering, generally resembling the far more common orange blossom orchid. But when it flowers, it is exquisite. Dark purple blotches stand out on cream petals, resembling a flock of butterflies come to rest on rainforest trees....Australia has 18 unique butterfly orchids, a number of which are under threat. As they are easily grown by orchid fanciers, they are often removed from natural locations and are becoming harder to see in their natural habitat, high up on rainforest trees in hilly terrain.
https://theconversation.com/the-exquisite-blotched-butterfly-orchid-is-an-airy-jewel-of-the-australian-landscape-121702

Botanic scientists in Sydney battle climate change

Scientists across Botanic Gardens in Sydney are using the latest science and technology to protect our flora from the impacts of climate change. Director Research & Chief Botanist Dr Brett Summerell is working with more than 50 world-class plant scientists at Australia's oldest scientific institution to undertake vital research that will safeguard plants and our future. A study by Dr Rachael Gallagher from Macquarie University in NSW looked at 2.5 million Australian herbaria specimens and found 47 percent of Australia's vegetation is potentially at risk from increases in mean annual temperature by 2070. "Rising temperatures and altered rainfall patterns are impacting our flora, which is further complicated by more frequent and severe wildfires, as well as increased outbreaks of disease and pest invasions," said Dr Summerell.
https://www.rbgsyd.nsw.gov.au/Stories/2019/Botanic-scientists-in-Sydney-battle-climate-change

Why is our rainforest on the rocks

The Horticulture team at the Australian Botanic Garden Mount Annan continue to work away at clearing the many weeds and invasive species across the 416 acres of diverse land in the Garden, with African olive (*Olea europaea* subsp. *cuspidata*) being the prime offender. It's hard to comprehend the scale of the ecological damage across Australia from plants that were introduced into the landscape and quickly became invasive. However, the Western Sydney Dry Rainforest (WSDR) is right here in our backyard and one of the more critical examples of a highly restricted endangered ecological community (EEC) and highlights how our biodiversity is under threat from invasive species.
https://www.rbgsyd.nsw.gov.au/Stories/2019/Why-is-our-rainforest-on-the-rocks

NSW MPs' debate on brumby petition begins

The NSW environment minister has told a debate over a controversial law which protects the Snowy Mountains brumby the government needs to "return to science". Labor MP Penny Sharpe earlier this year accepted a petition of more than 12,000 signatures to revoke the law giving heritage status to wild horses in Kosciuszko National Park. She has also introduced a bill in the NSW upper house to repeal the law - championed by Deputy Premier John Barilaro - that was passed in 2018 against the advice of ecologists, international conservation groups and the RSPCA.
https://www.canberratimes.com.au/story/6343331/nsw-mps-debate-on-brumby-petition-begins/?cs=14231

Otway rainforest's tall astelias have power to thrive if given a little light, scientists show

In a rainforest of lush ferns and towering eucalypts, the tall astelia stands out. Its large, almost yukka-like appearance would not look out of place at your nearest home hardware store. But this rare lily is something few people know about, let alone see. Just 10,000 of the plants are thought to still exist in isolated parts of Victorian forests, and deep in the Otway rainforest, one tiny population is clinging on. When Linda Parker first started her PhD in ecology at the University of Melbourne, she knew next to nothing about the tall astelia. "I didn't know much about the species. I'd seen it once and just thought it's a nice understorey herb but it doesn't do much," Ms Parker said.
https://www.abc.net.au/news/2019-08-25/why-scientists-are-trying-to-save-tall-astelia-in-the-otways/11442654
https://www.facebook.com/watch/?v=406068276692796

Trigger Happy: row over mapping laws to protect endangered plants

A row has erupted over state government mapping laws designed to protect endangered plants. Farmers are concerned that 'trigger maps' are flawed and could lock up their land.
https://www.abc.net.au/landline/trigger-happy:-row-over-mapping-laws-to-protect/11446502

Chinese-owned company loses appeal over bush clearing in WA's North West

A Chinese-owned company's appeal against a stop-work order over suspicions it destroyed a large portion of sacred bushland allegedly without the proper permissions in the North West has been largely dismissed. Zenith Australia Investment Holding, a division of Shanghai CRED, was ordered to stop clearing vegetation at Yakka Munga Station in the West Kimberley, 120 kilometres east of Broome, back in June. Native title group Walalakoo Aboriginal Corporation led calls to prosecute the company for the clearing of 120 hectares, due to conditions in the lease that required the international company to consult traditional owners on any work considered out of the ordinary. The WA government issued a vegetation conservation notice following the calls, that required "no further unlawful clearing occurred, effectively preventing any further excavation impacting on remnant vegetation within and next to the footprint of works."
https://www.watoday.com.au/national/western-australia/chinese-owned-company-loses-appeal-over-bush-clearing-in-wa-s-north-west-20190829-p52m4r.html

International Principles & Standards for the Practice of Ecological Restoration, 2nd Edition

The second edition of the International Standards for the Practice of Ecological Restoration was released on September 27, 2019, in Cape Town, South Africa at SER's 8th World Conference on Ecological Restoration. This groundbreaking publication provides updated and expanded guidance on the practice of ecological restoration, clarifies the breadth of ecological restoration and allied environmental repair activities, and includes ideas and input from a diverse international group of restoration scientists and practitioners. The second edition has been published as a stand-alone, open-access, special issue of Restoration Ecology. Download your copy of the second edition of the Standards in English, Chinese, or as a summary in English.
https://www.ser.org/page/SERStandards

2020 - International Year of Plant Health (IYPH)

In December 2018, the United Nations General Assembly declared 2020 as the International Year of Plant Health (IYPH). The year is a once in a lifetime opportunity to raise global awareness on how protecting plant health can help end hunger, reduce poverty, protect the environment, and boost economic development.
https://www.ippc.int/en/iyph/

2019 NSW Linear Reserve Environmental Management Forum presentations now available

This forum, hosted by the NSW Roadside Environment Committee with the theme 'Linear Reserves: Linking People, Nature and Infrastructure', focused on the environmental management of linear reserves (roadsides, travelling stock reserves, rail corridors and utility easements) across NSW. The day included presentations by industry professionals and leading experts on improving practices and case studies. Thanks to the cooperation of all the speakers, the presentations given on the day are available here
https://molinostewart.com.au/2019-nsw-linear-reserve-environmental-management-forum/

Royal Botanic Garden Sydney - Branch Out podcast

Listen to all five seasons of this award-winning podcast and discover the surprising world of plants with science and stories from Australia's oldest scientific institution.
https://www.rbgsyd.nsw.gov.au/Science/Branch-Out

Environment Department downgrades status of rare, vulnerable and endangered

Twenty-one SA animal and plant species have been pushed to the brink of extinction in recent years and will now be listed as endangered. The listings — which rank threatened living things as "rare", "vulnerable" and the worst "endangered" — have been recommended by the Environment Department and released for expert feedback....A mere 14 wild examples of the rarest plant to be listed as endangered — the Woods Well Spyridium — exist in the world, in one roadside population in the Coorong.
https://www.adelaidenow.com.au/news/south-australia/environment-department-downgrades-status-of-rare-vulnerable-and-endangered/news-story/f5be6a7a0d7c238da432d98ded6726ef

Goomalling's rare wildflowers stolen

The Shire of Goomalling says they're devastated by the theft of rare orchids from Konnongorring Reserve. The flowers - including the rare Blood Spider orchid pictured - had only just begun to bloom when they were dug up and taken. These orchids can only grow in extremely specific conditions. Even if they're planted somewhere else, they will still die.
https://www.facebook.com/abcmidwestandwheatbelt/photos/a.321716205984/10157203702725985/?type=3&theater

Endangered plant found in the ranges

Ecologists have made a significant discovery in the state's far north, uncovering large populations of a regionally critically endangered plant. The Freckled Duck is critically endangered in the Flinders Ranges but has been a target species for SA Arid Lands' Bounceback and Beyond program. The finding comprises a population of about 1500 plants at 10 different sites, stretching over a kilometre at a site east of the town of Copley. SA Arid Lands Community Ecologist Ben McCallum and DEW Principal Rangelands Ecologist Rob Brandle have been credited with the discovery. "We don't know a lot about this plant, but it is believed they grow in colonies in a specific soil type," Mr McCallum said.
https://www.transcontinental.com.au/story/6358032/endangered-plant-found-in-the-ranges/?fbclid=IwAR00w57g3DNd7B2HoZ6W9_BF427Dc0tMk2tTdt_wl5onXcirFn-_wUQQWMQ

New EPBC ACT Listings - Illawarra-Shoalhaven Subtropical Rainforest & Robertson Rainforest Threatened Ecological Communities

The Minister for the Environment, the Hon. Sussan Ley MP, has amended the list of threatened ecological communities under the EPBC Act to include two new critically endangered TECs. The two new listings are:
1/ The Robertson Rainforest in the Sydney Basin Bioregion. This rainforest is only found near Robertson in the Southern Highlands of NSW. It is critically endangered. Up to 85% has been lost and what remains in fragmented and under threat from clearing, invasive species, fire, under-scrubbing and weeds.
2/ The Illawarra-Shoalhaven Subtropical Rainforest of the Sydney Basin Bioregion. This rainforest is found below the escarpment of the NSW south coast. It is critically endangered. Up to 80% has already been lost and what remains is damaged and under further threat from clearing, fire, feral animals and weeds. Protection of this rainforest protects habitat for several threatened species including the Illawarra Socketwood plant and the Spotted-tailed Quoll.
http://www.environment.gov.au/biodiversity/threatened/communities
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=61&status=Critically&#43;Endangered
http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=148&status=Critically&#43;Endangered

Nearly half of Australia's native plants are under threat from climate change

Scientists are battling to save Australia's native species, with a nationwide study finding almost half are threatened by rising temperatures and erratic rainfall. Chief botanist at the Royal Botanic Garden Sydney, Dr Brett Summerell, is worried about the future of Australia's biodiversity. "Australia is a biodiversity hotspot since 85 per cent of our flora is endemic, so it occurs naturally nowhere else around the world. So if we lose a species here, it's gone forever," Dr Summerell said. "Rising temperatures and altered rainfall patterns are impacting our flora, and that is leading to increased outbreaks of disease and pest invasions."
https://www.sbs.com.au/news/nearly-half-of-australia-s-native-plants-are-under-threat-from-climate-change

'Dog's balls' shrub to be recognised as a new species, but colloquial name to remain

A fruit-bearing shrub long known as dog's balls might finally get the snip of its colloquial name. The bush, found across northern Australia and first discovered by Europeans near the Endeavour River in far north Queensland, has long been used by Indigenous people to treat dysentery and diarrhoea. But in modern European history, the plant's unusual appearance earned its equally distinct name. "Most people ask why is it called dog's balls until you show them a picture of the fruit," Russell Barrett from Sydney's Royal Botanic Gardens said. "Then the penny drops".
https://www.abc.net.au/news/2019-09-09/dogs-balls-shrub-to-be-recognised-as-new-species/11492066

Gold Coast hinterland fire prompts question — can rainforests burn?

Acting Queensland Premier Jackie Trad says the Gold Coast hinterland fire that swept through the area over the weekend included areas of rainforest — a highly unusual event, but one that appears to be occurring more frequently in recent times. University of Queensland Associate Professor Rod Fensham said it was "a bit premature to know to what extent the rainforest has burnt" but similar fires occurred in Central Queensland just last year. "You have to wonder about the effects of global climate change on our climate when it is less than a year [since] we had those really exceptional fires in Central Queensland," he said. "You might have been able to excuse them as a one-off event last year, but here we are less than a year later and we have another set of fires in Queensland.
https://www.abc.net.au/news/2019-09-09/gold-coast-hinterland-bushfire-why-rainforests-burn/11491364

I never thought I'd see the Australian rainforest burning. What will it take for us to wake up to the climate crisis?

These days as a climate scientist, the line of separation between the research I do in my professional life and the events unfolding in the world at large is growing ever thinner. The extreme events that our community has been talking about for decades are now becoming part of our lived experience, season after season, year after year across the entire planet. What we are seeing play out now is much faster than many of us ever imagined. Barely a week after sweltering through an Intergovernmental Panel on Climate Change (IPCC) lead author meeting discussing the UN group's sixth global climate assessment report during an unseasonable European heatwave, it's been surreal to return home to find much of Australia's eastern seaboard engulfed in unprecedented bushfires crisis. In spring.
https://www.theguardian.com/commentisfree/2019/sep/10/i-never-thought-id-see-the-australian-rainforest-burning-what-will-it-take-for-us-to-wake-up-to-the-climate-crisis?fbclid=IwAR2Wesvx9nI3Qn-Zh2_L4vmJMK494s5ydpvNvvDbyWoPfAJemcvZ7r1NG0c

Growing a rainforest

How an oil palm plantation owned by Christopher Skase was replanted by hand and transformed into a lush rainforest on the edge of the World Heritage-listed Daintree National Park. When Joe Reichl first set foot on the 27-hectare block known as Lot 46, it looked like a dump. It was littered with car bodies, dilapidated sheds and covered in weeds and brambles several metres high. Then there were the exotic oil palms — more than 120 of them — which were the remnants of a plantation once owned by the tycoon-turned-fugitive Christopher Skase. "It was left to rack and ruin, virtually," Mr Reichl said. Within a decade, the property would look unrecognisable.
https://www.abc.net.au/news/2019-09-15/growing-a-rainforest-on-land-once-owned-by-christopher-skase/11448566

Locals launch war on the arum lily, a beautiful but deadly weed

Arum lilies may be visually spectacular, but for more than 100 years they have been wreaking havoc on the bush in the South West corner of Western Australia. The South African plants have taken over huge swathes of the bush, choking out native flowers and killing livestock. Now locals and volunteers are waging war in a bid to reclaim the bush. Genevieve Hanran-Smith works for Nature Conservation Margaret River and much of her working life is spent trying to stamp out the beautiful flower. "I think tourists think they are nice. But locals who really love and value this area and the diversity of the natural landscape find them [lilies] really ugly because they are so invasive," she said.
https://www.abc.net.au/news/2019-09-21/arum-lilies-killing-the-australian-bush/11507784

Rising temps risk wildlife, iconic parks

Australian wildlife is under threat and forests that don't normally burn are being devastated by fire, with ecosystems already suffering from climate change, a new report suggests. The Climate Council report found sensitive vegetation that's never been subject to fires before is burning, ringtail possums and flying foxes are dying from heatwaves and river catchments are losing mangroves due to underwater heatwaves. "In Queensland we are seeing bushfires burning into rainforests that have basically never had bushfires before," report author Lesley Hughes told AAP. Professor Hughes warned that climate change is not a future problem but a problem that needs to be addressed now. "What we are seeing is devastating impacts that have occurred with about one degree of warming," she said.
https://www.canberratimes.com.au/story/6389309/rising-temps-risk-wildlife-iconic-parks/?cs=14231

Welcome to Lady Elliot Island — the postcard-sized gem brought back from the brink

There's a very hungry creature on the pristine Lady Elliot Island, which sits on the southern tip of the Great Barrier Reef off Queensland's Fraser Coast. No, it's not the reef sharks, sea turtles, manta rays or array of other colourful characters that make snorkelling and diving off this postcard-sized gem such a joy. It's a huge food scrap-eating giant known as OSCA, who turns kitchen waste and cardboard into life-giving compost….. The final product will go to revegetating the coral cay that had a metre of topsoil ripped up as part of guano (bird poo) mining operations in the 1860s.
https://mobile.abc.net.au/news/2019-09-29/lady-elliot-island-great-barrier-reef-restored-mining/11549832?fbclid=IwAR22IxOT-q-5ZL0YNXFd_jACmQ3Sr5qh7ErD6uWPb2OL8erooK_PGoYFkyg

Stamps that sow the seeds of conservation

Humans rely on plant diversity for fresh air and water, food security, shelter and medicines, as well as a clean and healthy environment capable of adapting to climate change and other serious threats. Seed conservation provides a way to maintain the genetic diversity of native flora, so that it is available for future generations.... To recognise the importance of this work, the Seed Banking Australia stamp issue is being released on 8 October 2019. The stamps, designed by Sonia Young of the Australia Post Design Studio, present seeds of three native plant species: *Rytidosperma clelandii* (a rare, perennial grass from South Australia), *Epacris petrophila* (a near-threatened alpine shrub from the Australian Alps and high-altitude areas in Victoria and Tasmania) and *Petrophile latericola* (an endangered shrub from Western Australia).
https://australiapostcollectables.com.au/articles/stamps-that-sow-the-seeds-of-conservation

National monitoring priorities, process and prospectus for threatened species

Monitoring should be a critical component of recovery for threatened species and ecological communities. In a comprehensive review, the hub noted some exemplary monitoring programs for some threatened species; however, for many threatened species there was no monitoring, and the existing monitoring programs for most threatened species were suboptimal. Reasons include the challenges of coordinating diverse stakeholders, and the perception that monitoring programs for threatened biodiversity are difficult and expensive. This project aims to develop plans for monitoring programs for key groupings of threatened species, plus costed pathways for their implementation. It will also identify threatened species that have had little or no monitoring to date, and prioritise those threatened species for which new or enhanced monitoring is most critical.
http://www.nespthreatenedspecies.edu.au/projects/factsheet-national-monitoring-priorities-process-and-prospectus-for-threatened-species

An antidote to despair

Rather than lose hope when eucalypts started dying in central Victoria, Bush Heritage scientists came up with an innovative solution using future climate scenarios. In the middle of a cleared paddock on a cold and foggy winter morning, Dr Garry McDonald and several Bush Heritage staff huddle together to run through their game plan one last time. Then, tray by tray, they start unloading their precious cargo from the backs of their white utes. The trays are filled with Grey Box and Yellow Box seedlings that have been germinated from seeds collected at different locations (known as provenances) across south eastern Australia.
https://www.bushheritage.org.au/newsletters/2019/spring/antidote-to-despair?utm_term=bushtracks-antidote-to-despair&utm_campaign=spr-19-news&utm_medium=email&utm_source=bbcrm&utm_content=lv

The showy everlasting is endangered, but a primary school is helping out

Western Australia boasts seemingly endless fields of pink, white and yellow everlasting daisies. But while there might seem to be an infinite number, one species in particular is actually endangered. The showy everlasting (or *Schoenia filifolia* subsp. *subulifolia*) once grew in the Mid West of WA. Now it is found in just a few spots around the tiny inland town of Mingenew. But a WA primary school is helping my colleagues and me save the beautiful showy everlasting. With new seed banks, a genetic project and a whole lot of digging, we're hopeful we can keep this gorgeous native daisy around for the next generation.
https://theconversation.com/the-showy-everlasting-is-endangered-but-a-primary-school-is-helping-out-123523

Restoring Australia's coastal ecosystems reportedly equivalent to taking four million cars off the road

New world-first research says restoring Australia's marine ecosystems would significantly help fight climate change and create tens of millions of dollars' worth of carbon credits. Restoring Australia's damaged wetlands and coastal vegetation would have the same impact on the fight against climate change as taking over four million cars off the road, world-first research says. Researchers from Perth's Edith Cowan University have helped an international team of experts pinpoint the volume of greenhouse gas absorbed and released by Australian marine ecosystems, known as "blue carbon". Published in the Nature Communications journal, the paper says Australia's coasts are a global carbon storage hotspot, absorbing 20 million tonnes of carbon dioxide annually.
https://www.sbs.com.au/news/restoring-australia-s-coastal-ecosystems-reportedly-equivalent-to-taking-four-million-cars-off-the-road?fbclid=IwAR2CMLsMEgP9S-_rXw5I0gvmTgEbVW2ROijjAf0D2rClBrW1ExGIB20Q89g

Extent of fire damage in Gold Coast rainforest revealed

Analysis of satellite data suggests more than 440 hectares of unique sub-tropical rainforest was damaged in the recent Gold Coast hinterland fires. Griffith University researcher Patrick Norman says the most intense rainforest fires appear to have occurred on remnant blocks on private land, but there was also considerable damage within the World Heritage-listed Lamington National Park. "I would never have thought this larger swathe of rainforest could burn in this park," he told 7.30. Rainforest fires are rare, according to Queensland Herbarium ecologist Dr Rod Fensham. "Rainforest is fire retardant," he said.
https://www.abc.net.au/news/2019-10-02/extent-of-fire-damage-in-gold-coast-rainforest-revealed/11567574

How to save the planet? Overcome plant blindness

We hear much about the urgent need to save the koala as it possibly heads towards extinction – and yes, this is essential and critical. To lose such an amazing animal that is a member of a unique evolutionary lineage would be a disaster and reflect very poorly on our stewardship of the planet. Occasionally, there is discussion around protecting the koala's habitat – but done in a vague nebulous way that doesn't really imply what it is. It is, of course, plants. To be more accurate, in this case, eucalypt woodland and forest that provides both food and habitat for koalas and is absolutely fundamental to their survival. Simply put - no eucalypts, no koalas. This phenomenon, where plants are ignored, has been termed "plant blindness".
https://www.smh.com.au/national/how-to-save-the-planet-overcome-plant-blindness-20191003-p52xd0.html

Large old trees in the Victorian Central Highlands

Prof David Lindenmayer from The Australian National University talks about the essential role that large old trees play in the forests of the Victorian Central Highlands, and also why we should be worried about them.
https://www.facebook.com/nespthreatenedspecies/videos/698450923993125/

Kangaroos (and other herbivores) are eating away at national parks across Australia

Protected land, including national parks, are a cornerstone of conservation. Once an area is legally protected, it is tempting to assume that it is shielded from further degradation. However, our research, published in the journal Global Ecology and Conservation, has found Australia's national parks are under serious threat of overgrazing. Significantly, native kangaroos are major contributors to the problem. In some places we looked at, the effect of overgrazing in protected areas was just as pronounced as on private land with no legal protection at all. In the public debate over culling and otherwise managing kangaroo populations, attention is typically divided between their economic impact on people versus welfare concerns. But there's a third unwilling participant in this dilemma: the thousands of other native species affected when native grazer populations grow out of control.
https://theconversation.com/kangaroos-and-other-herbivores-are-eating-away-at-national-parks-across-australia-122953

Keen to plant natives? Start with these seven

While most of us could recognise a rose or a tulip, very few of us know more than a handful of our native plants. This is a shame, as there's well over 19,000 of them, including some of the world's most fascinating. Growing some local plants in your garden can help support native wildlife, providing food and a safe place to rear their young. As well as being perfect partners for birds and insects, they're also perfectly suited to our soil, climate and conditions, so often grow better. And, needless to say, most of them are beautiful. If you'd like to plant natives, the first thing to recognise is your location. Within each area of the country you'll find plants specifically adapted to windy escarpments, protected gullies, desert or rainforest. This means a successful native garden is one where you've looked at your conditions and found plants to suit, not vice versa.
https://www.abc.net.au/life/native-australian-plants-for-your-garden/11589742

Experts explore impacts of bushfire to rare lichen colonies on Mount Canobolas

Lichen experts examined the effect of the February 2018 bushfire on endangered lichen colonies, which were unique to Mount Canobolas, recently. The two Canberra-based scientists assessed any damage and gave maintenance advice to the National Parks and Wildlife Service for four lichen species that occur nowhere else in the world. Orange-based Dr Richard Medd invited Dr Patrick McCarthy, who was an expert lichen taxonomist, and Professor Jack Elix, who had a chemistry background that he used to help identify lichens and explore their complex biochemistry, to visit the Mount Canobolas State Conservation Area.
https://www.centralwesterndaily.com.au/story/6433630/often-overlooked-experts-examine-impact-of-bushfire-on-rare-species/?cs=9402

A native plant is exposing the clash between traditional knowledge and Western conventions

Wiradjuri Ngemba woman Roxanne Smith says her family has used gumby gumby “for probably centuries”. The plant, also known as native apricot, comes from inland Australia, including the Wiradjuri lands of central NSW. Aboriginal people use it as medicine to treat eczema and other skin problems, sprains and colds and induce milk flow in new mothers. “It’s a really good, strong medicine and it’s been proven in Griffith University scientific tests that all the things we used it for … that’s what it does and more,” Smith says. Now a fight is brewing over ownership of gumby gumby, exposing the clash between traditional knowledge and the Western intellectual property (IP) system.
https://www.smh.com.au/business/the-economy/a-native-plant-is-exposing-the-clash-between-traditional-knowledge-and-western-conventions-20190925-p52upf.html

Environmental Levy helps secure key Logan green space

Logan City Council has purchased a 47-hectare parcel of land at Bahrs Scrub for conservation. The land is a koala habitat and contains several rare tree species. Half of the site is rainforest. It also includes the bush tucker species small–leaved tamarind. It is the first time the small-leaved tamarind has been found this far north. Its most common distribution area is the Gold Coast’s Tallebudgera Valley. Two new species of plant have been found on the site and named after the suburb. They are the Bahrs Scrub croton and Bahrs Scrub devil’s needles. The area also contains the endangered shiny-leaved Coondon, native Macadamia trees and several blue gums estimated by a botanist to be hundreds of years old.
https://www.logan.qld.gov.au/about-council/news-and-publications/media-releases/media-releases/environmental-levy-helps-secure-key-logan-green-space?fbclid=IwAR0GRP7d9nnmSmdWVASmCmo06RRpgUL5DCbZVK0gbBqfMIg4UfjcIbrxivM

Seagrass nursery in central Queensland could offset carbon emissions

A central Queensland seagrass nursery set up to propagate seeds and ultimately restore lost seagrass meadows could also be a tool to offset carbon emissions. About half the seagrass habitat has been destroyed in the port city of Gladstone over the past 20 years, impacting on fish stocks and coastal environments. But new research has found that seagrass, along with mangroves and salt marshes, absorbs millions of tonnes of carbon dioxide in Australia each year, and this nursery could play an important role.
https://www.abc.net.au/news/2019-10-24/seagrass-propagation-project-and-blue-economy/11631944

Scientists warn of “extinction crisis” in open letter to PM

Two-hundred-and-fifty Australian scientists have written an open letter to Prime Minister Scott Morrison today, warning that Australia is in the midst of an “extinction crisis” and calling on him to strengthen Australia’s environment laws. The scientists have timed their letter to coincide with a Federal review of Australia’s key environmental protection law. They say that government action is urgently needed to stop the destruction of habitat that is now threatening even once common native animals like koalas.
https://www.abc.net.au/radio/programs/worldtoday/scientists-warn-of-extinction-crisis-in-open-letter-to-pm/11645944

Govt to review environmental laws as scientists warn of extinction crisis

The Federal Environment Minister Sussan Ley will today announce a review of the nation’s environmental laws: the Environment Protection and Biodiversity Conservation Act. It comes as conservation scientists warn of an “extinction crisis” unless the laws are beefed up and properly enforced. The Government is planning to significantly expand its network of Indigenous Protection Areas which should help protect some native species.
https://www.abc.net.au/radionational/programs/breakfast/environmental-law-review-as-scientists-warn-of-extinction-crisis/11648618

Morrison government announces pick for environmental law review

The Morrison government is tapping former competition regulator chief Graeme Samuel to head a once-in-a-decade review of Australia's main legislation protecting environmental values of national and international importance. Environment Minister Sussan Ley said Professor Samuel, ex-chair of the Australian Competition and Consumer Commission, will lead the year-long review of the Environment Protection and Biodiversity Conservation (EPBC) Act to "tackle green tape and deliver greater certainty" to business, farmers and conservation groups.
https://www.smh.com.au/environment/conservation/clean-skin-samuel-picked-to-head-environmental-law-review-20191029-p5357e.html

Review of federal environment laws will cut 'green tape' and speed up approvals

The Morrison government has promised a review of national environmental laws will "tackle green tape" and reduce delays in project approvals that it said costs the economy about $300m a year. Hundreds of scientists have asked the government to use a legally required review of the Environment Protection and Biodiversity Conservation Act (EPBC) to strengthen the legislation so it could be used to stem a worsening extinction crisis. Announcing the review on Tuesday, Sussan Ley, the federal environment minister, emphasised the government's goal was to deliver greater certainty to business groups, farmers and environment organisations.
https://www.theguardian.com/environment/2019/oct/29/review-of-federal-environment-laws-will-cut-green-tape-and-speed-up-approvals.

Other conferences, courses and events

Updates available at:
http://anpc.asn.au/other_conferences_and_events

22nd Australian Weeds Conference – Adelaide SA, 25–29 October 2020

The Weed Management Society of South Australia (WMSSA), on behalf of The Council of Australasian Weed Societies (CAWS), will be hosting the 22nd Australasian Weeds Conference (22AWC) at Adelaide Oval from 25-29 October 2020. Topics to be discussed range from cutting edge weed science and research, to local and national innovative policy, new operational practices and tools, best practice on-ground management, chemical innovations, alternative weed control, and on-ground case studies, all helping to protect our agricultural and environmental landscapes from weed threats.
http://wmssa.org.au/22awc/

NSW Nature Conservation Council's 2020 Bushfire Conference – Sydney NSW, 19-21 May 2020

The NSW Nature Conservation Council's Bushfire Program is hosting it's 12th Biennial Bushfire Conference, 'Cool, Warm Hot: the burning questions', to bring together academics, agencies, Traditional Owners, practitioners and communities to explore how different fire intensities can influence ecosystems and communities in a changing climate. Presentations will investigate the effects of low, medium and high intensity fires on the four sub-themes: climate change; fire ecology; ferals, weeds and restoration; and community resilience. The conference will examine how to incorporate and respond to cool, warm and hot fires in fire management as part of an optimal fire regime to achieve multiple objectives for biodiversity and cultural values, hazard reduction objectives and community resilience.
https://www.nature.org.au/healthy-ecosystems/bushfire-program/bushfire-conference-2020/

Research round up

COMPILED BY KIRSTEN COWLEY

Centre for Plant Biodiversity Research, Canberra. Email: Kirsten.Cowley@csiro.au

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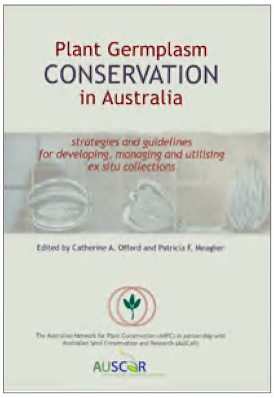

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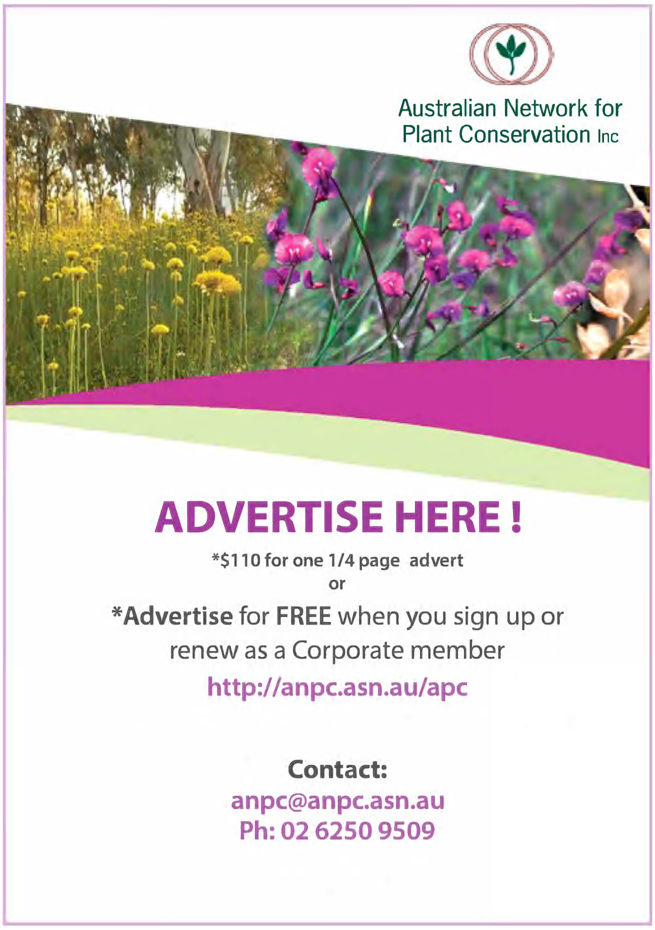
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AUSTRALASIAN Seed Science Conference

The Australasian Seed Science Conference 2020 is being coordinated by the Australian Seed Bank Partnership and will be hosted by the Australian National Botanic Gardens in Canberra. The Conference aims to attract up to 200 delegates who will have the opportunity to meet and share ideas, focusing on the importance of seed science to the future of plant conservation and food security.

The conference will be delivered across four themes:

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Seeds in culture and society – Sharing stories and learning about cultural seed use, including collaborations between traditional use and ex situ seed banks and gene banks.

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The Australasian Seed Science Conference will be hosted by the Australian National Botanic Gardens and delivered in collaboration with the Australian Network for Plant Conservation, Australian National University, Australian Grains Genebank and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). We wish to thank our major sponsors, the Friends of the Australian National Botanic Gardens, the Council of Heads of Australian Botanic Gardens, and Wiltshire and Dimas Management at the ANU Kambri Centre.

For more information about the conference program and to register:

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